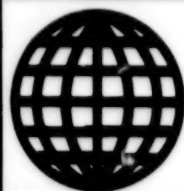


JPRS-EST-93-025

3 August 1993



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JPRS-EST-93-025

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ADVANCED MATERIALS

France: Patterno Engineering Firm Conducting Polymer Research

93WS0589B Paris INDUSTRIES ET TECHNIQUES
in French 7 May 93 pp 93-94

[Article by Michel Le Toullec: "The New Conductive Plastic Is Here"; first paragraph is INDUSTRIES ET TECHNIQUES lead]

[Text] Patterno has developed a polyacetylene-related polymer for armoring and static electricity dissipation applications.

This new episode in the saga of conductive plastics could well be the epilogue. Patterno, a Toulouse engineering firm specializing in electromagnetic compatibility, has announced a conductive plastic that is both chemically stable and cheaper than its competitors. Patented four months ago, this intrinsically conductive plastic, Thermocem, is related to polyacetylene. If you have assiduously followed developments on this material, your first reaction should be, "What, polyacetylene? That material known to be the most conductive of all—almost as efficient as copper—but so unstable that everyone had abandoned it?" Yes, polyacetylene; but synthesized in a different manner and, more importantly, oxidation-stabilized.

With this material, Patterno is targeting the very broad electromagnetic armoring and static electricity dissipation market. Its structure gives it a natural conductivity of 0.01 to 100 S/cm (siemens per centimeter). Doping (including with iodine) makes it possible to boost this conductivity to 0.1 to 1,000 S/cm. The material will be used mainly as an electrically active filler in combination with other plastics (polyvinyl chloride, polyamide, polycarbonate, polyurethane, polyimide, etc.) in much the same way as the carbon black or metal fillers already on the market, but without the problems they cause. These fillers affect the mechanical properties of the plastic matrix containing them, creating abrasion problems with the material in actual usage.

Electromagnetic armoring applications will use formulations with about 10 percent Thermocem. The conductivity obtained will be on the order of 10 S/cm. It will be possible either to manufacture parts (by injection, extrusion or vacuum molding) or to coat other parts with a conductive film. Planned applications include electronic circuit components, microcomputer chassis, and anti-radar paints for avionics. There are also plans for armoring composite structures in aircraft. Patterno is talking with Vetrotex, a supplier of composite-reinforcement glass fibers. The idea is to reduce problems with interference among the various airborne electric and electronic devices by impregnating the glass fibers with the conductive polymer.

Electrostatic charge dissipation can be achieved with lower percentages of Thermocem in the matrix—on the order of

2 to 3 percent. In these formulations, the conductivity of the mixture is about 0.0001 S/m. At a level of 2 or 3 percent, the material also has the advantage of not affecting the color or even the transparency of the matrix (unlike carbon black fillers, of course). Plastic parts made with such a mixture would no longer accumulate dust.

The new version of polyacetylene, Thermocem, is an intrinsic conductor with double and single carbon-carbon bonds which provide the ideal path for electron conduction. Conventional polyacetylene was often synthesized by polymerizing acetylene. Unfortunately, the resulting plastic was not only unstable but also very expensive: on the order of 1,000 French francs [Fr] a kilogram. Patterno set out to find a process that would yield a mass market product. The company opted for the dehydrochlorination of PVC (polyvinyl chloride), one of the most common plastics. The price should range between Fr60 and Fr100 a kilogram. For a chemist, the reaction is straightforward. By eliminating a hydrogen atom and a chloride atom on two adjacent carbon atoms of the PVC, a double carbon-carbon bond is produced, as in the acetylene polymerization reaction. (In fact, the final product is not really polyacetylene because dehydrochlorination is not complete. This is why Patterno prefers to speak of dehydrochlorinated PVC rather than polyacetylene.)

Next it tackled the oxidation stabilization of the material. The idea was to create what are called charge transfer complexes by partially oxidizing the material using a compound more reactive than oxygen. Sulfur is the most appropriate choice. However, introducing molecules of sulfur would have an unfortunate tendency to lower the material's conductivity. This is what inspired the idea of using thiophene to introduce sulfur in organic form. The results of durability testing in an oxidizing atmosphere show that there has been no oxidation in eight months, or since the tests began. This "functionalization" also makes it possible to alternate double and single bonds in a second direction in space (see diagram) [not reproduced], which means that conductivity is more homogeneous.

In synthesizing this new material, Patterno received expert assistance from the macromolecular chemistry laboratory in Marseilles. This laboratory was helpful in particular with respect to the functionalization of the material.

Pre-industrialization was done at a pilot unit at the National Higher School of Chemistry in Montpellier. The company is talking with General Electric Plastics about production of the "pure" material. Manufacturing of Thermocem mixtures and plastic matrices should be entrusted to 3C High Tech Compound, near Marseille. Production is now only a matter of months. Of course, Patterno is not in the production business. However, because of the success of its work, it can now envisage

going from the status of an engineering firm to that of a company taking research contracts in this particular niche.

[Box, p 94]

The Conductive Polymer Family

The conductive polymer family has two branches: the extrinsic conductors and the intrinsic conductors. The former are obtained by incorporating conductive particles (carbon black or metal) into a plastic such as PVC or polyamide, which makes the plastic conductive. Intrinsic conductors come in two forms. There are the ionic conductors, which, apart from being solid, closely resemble liquid electrolytes; in other words, conduction is produced by the movement of ions through the matrix. For example, lithium perchlorate dissolved in a plastic such as ethylene polyoxide produces an electrolyte comparable to salt dissolved in water. Then there are the electronic conductors that "conduct" electrons through their carbon-carbon bonds. This category consists mainly of polyacetylene, polypyrrole, polythiophene, and polyaniline. Their current or potential uses range from hearing-aid-type batteries to electrochromic glazing and antiradar paints.

United Kingdom: Plating Process Quintuples Corrosion Resistance

BR2707124993 *Toddington NEW MATERIALS INTERNATIONAL in English Jul 93 p 6*

[Unattributed article: "Five-Fold Rise in Corrosion Resistance"]

[Text] A new plating process has been introduced by Advanced Surface Treatments Ltd (AST) of Coventry. Called Advacote ZN, it is a zinc nickel alloy process that offers corrosion resistance in excess of other similar finishes currently available, it is claimed.

The process has been developed by an international chemical company and AST is the first in the West Midlands to make it available for general use.

The development is a direct result of the increasing pressure on manufacturers, particularly in the automotive industry, to provide improved quality and longer guarantee periods for their products. Similar processes have been introduced by the Japanese car industry in recent years and are now being specified in the UK.

David Stevens, managing director of AST, claims the new process gives an improvement in terms of corrosion resistance over standard zinc plating of a least four to five times with only a moderate increase in cost.

"This type of improvement in quality and rust prevention must be a major incentive for it to be increasingly specified. I am sure our commitment and investment in the process will be quickly justified," he said.

AST has already processed sample components for a number of major manufacturers, and independent laboratory tests confirm the claims made for the process.

AST was formed in 1990 by Stevens and his partner Russel Hemmings. The company has doubled its size and workforce in three years. The main volume process is still zinc plating to specification and AST specialise in the manual plating of tubular components for the car industry. This ensures that the problems encountered by other companies with automatic plant [as published] on this type of product are virtually eliminated, it is claimed.

The company has gained favour with existing and new customers alike for its reliability, quality, and service and it has recently installed all the necessary systems and equipment to make an application for BS5750 Pt2.

Electroless nickel and heat treatment facilities were installed in 1991 and AST is now a major supplier of this process throughout the Midlands.

Details of the process and a laboratory report are available from AST Ltd., Paradise Industrial Estate, Eden Street, Coventry CV6 5HE, UK; phone: +44 203 684 993.

Nordic Industrial Fund Promotes Light-Weight Materials R&D

BR1907150293 *Oslo NEW SCANDINAVIAN TECHNOLOGY in English No 2, 1993 p 6*

[Article by Svein Oestevik of the Nordic Industrial Fund: "Saving Resources: Nordic Industrial Fund Focuses on Light-Weight Structures"]

[Text] The Nordic Industrial Fund (NIF) is focusing on the research and development of light-weight structures as a means of saving resources. Particular importance is being attached to polymer, aluminium, and magnesium materials. (Nordic Industrial Fund; Nedre Vollgate 8, N-0158 Oslo, Norway; phone: +47- 22-416 480; fax: +47-22412 225)

Research and development pertaining to resource-saving light-weight structures is to be given priority by the Nordic Industrial Fund in a program lasting four years. This was the decision by the fund's board at the start of the year.

Light-weight structures can be used in many applications, for example in the transport sector, in offshore construction, in the space industry, and as special products in the engineering and processing industries.

"We have good prospects in the Scandinavian countries," explains Svein Oestevik at the Nordic Industrial Fund, "especially considering the fact that raw materials, such as polymers, aluminium, and magnesium, used in many light-weight structures are produced in Scandinavia."

Recycling Trend

"A trend that we've noticed in the programme is the growing importance that the life-cycle costs of materials have, taking into consideration the consumption of energy and recycling potential. Other trends are the increased use of low-weight products and the increased demands for health, safety, and quality.

"All materials that lend themselves to light-weight structures having high strength and low weight will be included in the programme. A prerequisite, however, is that the structure, from a perspective of total life cycle, will result in resource savings compared with existing solutions. In this, attention will be paid to the entire life cycle, from the extraction of the raw materials through manufacture and end-use to final recycling," says Mr. Oestevik.

Transport Sector

The transport sector is of particular interest in this connection. Some 5-10 percent of its total energy consumption is taken up by manufacture; 80-90 percent, during use; and 5-10 percent, during destruction and recycling. Light-weight structures will thus provide an extensive saving of resources.

The transport sector, per se, is of vital importance in Scandinavia, with its widely scattered inhabitants and long distances and the need to ship raw materials as well as industrial products to market.

Plastic-Based

In order to focus on resource-saving light-weight structures, a research consortium will be established in the field of composites and sandwich materials that will consist of at least one central institute in each country. The consortium will cover R&D in plastic-based materials. Industry will have a good opportunity to manage the consortium and the activities of the projects.

Two subsectors in the field of metals are defined: first, design and production optimization and, second, moulded components for light-weight structures. The financial framework of the programme is some 200-300 million Norwegian kroner. During the preproject period, more than 200 ideas were received by the Nordic Industrial Fund. At the present stage, the companies and research institutes of interest will be providing more detailed proposals to enable the programmes to start up after the summer months.

AEROSPACE

Germany: Automation of Transonic Wind Tunnel Completed

M11607081793 Cologne DLR NACHRICHTEN
in German May 93 pp 2, 4-7

[Article by engineer and mathematician Werner Sachs of the DLR [German Aerospace Research Institute] Wind

Tunnels Division: "DeAs: A Programming System for Data Collection and Plant Control—Development of New Software for Wind Tunnel Operation"—first paragraph is DLR-Nachrichten introduction]

[Excerpts] The modernization of the transonic wind tunnel in Goettingen (TWG) has largely been completed. Apart from improvements to the flow quality, stored program control (SPC) and a new programming system have been introduced to automate the plant. [passage omitted]

The DeAS (data collection and plant control software) program system is based on a theoretical analysis of Flexible Automated Data Collection from Experiments (FADE) carried out jointly by the DLR's Wind Tunnels Division, the Institute of Experimental Flow Mechanics, and the Data Processing Division in Goettingen. DeAS comprises a number of programs that communicate with each other, providing up to date support for the operation of plants, particularly wind tunnels.

Up to date, from the user's point of view, means that DeAs:

- Runs on networked workstations under UNIX;
- Is windows-oriented throughout and based on the Massachusetts Institute of Technology's networkable windows system X11;
- Can accommodate stored program controls (SPC) and interface with a wide range of data collection systems;
- Offers the user comprehensive, interactive 2-D and 3-D visual display options;
- Uses a desktop publishing (DTP) program that can readily import and rework the 2-D and 3-D graphics obtained from the visual display parts to prepare documents;
- Provides user-friendly data archiving support.

DeAs is used directly by the people who deal with customers (from outside), the test engineer responsible for the wind tunnel model and metrology, and the plant operator responsible for running the plant. DeAs is designed to give these users comprehensive and, as far as possible, full support during experiments, from preparations through procedures to test evaluation.

Hardware—Overall Concept

Figure 2 [not reproduced] outlines the hardware used or supported by DeAs. What is striking about it is the extremely simple structure. DeAs is designed to run exclusively on a master test computer. No additional data collection and evaluation computers are required with this solution.

The master test computer has the following three physical interfaces:

1. To the department or research center local area network (LAN), which is an Ethernet with TCP/IP [transmission control protocol/internet protocol].
2. To the data collection system and subsystems; in the first version of DeAs, this interface will allow data collection equipment based on IEEE488 to be linked up to RS232, although the open design of DeAs means that complex data collection systems (e.g., a subsystem for recording non-stationary processes) can simply be linked up to it.
3. To the SPC with Ethernet and OSI [open system interconnection] protocol.

DeAs's great flexibility is achieved by networking the master test computer in the LAN and using only networkable software. It thus emerges, for example, that a graphic display of the measuring data and test parameters can be viewed simultaneously on any computer in the department, even during the current test. A curious possibility would be, for example, to run a plant at location A from a computer at location B. Provided access is authorized, all that is needed from the technical point of view is a single command. For the planned wind tunnel application, however, the computer will continue to be used on site.

Software—Overall Concept

Figure 3 [not reproduced] outlines the DeAs software system. The arrows indicate the data flow directions between the individual sections of the system. As will be seen from the illustration, the structure of the software system can be divided into three areas:

—Plant software, comprising test support and test execution programs; test support programs provide user-friendly input and processing of test description data from models, systems, equipment, etc., whereas the test execution programs primarily ensure that the measuring program instructions are reliably processed.

Evaluation: DeAs offers the scientific operator transparent interfaces to the raw data, the 2-D and 3-D visual display tools, and the DTP facility. Programs for aerodynamic evaluation written by the operator/customer in the form of (UNIX) filters can thus be integrated very simply into the overall system.

Visual display, DTP: DeAs takes tests right through to complete evaluation and documentation. The Highend visual display package developed by the DLR Institute of Theoretical Flow Mechanics is used for 3-D visual data (pressure distribution, velocity fields, etc.) display. General, multidimensionally structured and unstructured data can thus be displayed by a mouse control. The Highend package is freely available to every DLR user.

The "xvgr" program is used for 2-D visual display. The public domain program functions are so extensive and

exhaustive that a detailed description cannot be given here. It should be noted, however, that as well as operating interactively, this program can also be used as a filter, so the expression of 2-D graphics can be automated.

The FrameMaker DTP program, which also easily imports the 2-D and 3-D visual display program graphics, is used to document the test. FrameMaker can even be used to alter any section of an object (line, font, print etc.) of imported 2-D graphics at a later stage.

The "netCDF" box shown in the flow diagram allows the individual DeAs components to communicate with one another and exchange and archive the data obtained during the test. With netCDF and its interface, the best data format available to date for this range of applications is being used.

Object-Oriented Design, Object-Oriented Programming

DeAs is of completely object-oriented design. The implementation, i.e., the concrete translation of the design into a program or system of programs, is written in the object-oriented programming language C++. [passage omitted]

Compared with C, C++ has only a few new language elements, but functionality is substantially enhanced. The four major new features will be presented briefly.

Class and object: The most important new language element is the class concept. A class is a definition of data structures and of the functions that alter these data structures. A new feature is the joint description of data structures and functions. Objects are the concrete representatives of the class; they correspond to the variables of conventional programming.

Data hiding: Parts of the data and functions can be altered or used locally, i.e., only in the object itself. The object functions or data are then referred to as "private." Other parts, on the other hand, are "public," i.e., they can also be used by other objects.

By way of an example, let us define a "wind tunnel" class. Let this class have only the variables "Mach number" and "cooling water temperature." Let the functions of the class be "set Mach number," "test cooling water temperature," and "adjust pump." The "set Mach number" function must clearly be public, whereas the "cooling water temperature" and the "test cooling water temperature" and "adjust pump" functions should not be visible externally, i.e., they should be private. The advantage is obvious. From "outside," this class's only option seems to be setting the Mach number. The cooling water is prevented covertly from overheating in the class by the "adjust pump" function. Concurrent functions outside the class are not permitted (as the proverb goes, too many cooks spoil the broth). As the "cooling water temperature" is local (private), it cannot be accidentally overwritten from outside either (data hiding).

Inheritance: Definitions of data structures and class functions can be handed on. As with human beings, where many parental characteristics are inherited by the child, objects

can inherit the characteristics of parent objects. In C++, the inheritance mechanism drastically reduces the writing time and the code. It should be noted that, as with human beings, both the "positive" and the "negative" characteristics can be passed on. The class from which characteristics are inherited (base class) must therefore be developed and tested with great care.

Polymorphism: This, the fourth most important characteristic of object-oriented programming language, is exploited to a very large extent in DeAs. Polymorphism means "diversity." Objects that are similar but do not belong to the same class can be processed with the same method. DeAs makes great use of a list management facility. There are lists of objects in the "plant," "model," "measuring equipment" etc. classes in DeAs. When conventional programming languages are used, it is not immediately possible to program list management (e.g., erase element, add element etc.) that can be used for all the objects from very different classes. C++, into which "virtual functions" have been introduced, does, however, offer this option.

Class Category Diagram

Object-oriented design can be carried out by different methods. The development method used with DeAs is that of Booch (Grady Booch, Object-Oriented Design with Application, 1991); as it permits extensive and differentiated description of classes and objects. Figure 4 [not reproduced] shows the uppermost level of the design hierarchy. Each box represents a category of classes, which is tantamount to combining classes to form one unit (super classes). The arrows describe a user relationship, where A-arrow-B means A uses B.

The most important class categories in DeAs are "specify executive program" and "execute executive program." First of all, these parts are often used together with the (external) customer, i.e., they also act as an attraction; moreover, well thought-out intuitive user training, particularly in the "execute executive program" class category, increases the operating safety of the plant, as faulty inputs are largely avoided.

Database or "Intelligent File Format" With Comprehensive Software Interfaces?

The decisive questions here are:

- What happens with the experimental data?
- In what form should the experimental data be stored for further in-house processing and archiving?
- In what form does the customer receive the experimental data?

The concept of portability is crucial here.

The following experimental data storage options are available:

1. The data can be stored in a file with its own specification.
2. The data can be filed in an (object-oriented) database.

3. The "netCDF" format can be used.

Option one is a "special solution" and, as such, has mainly disadvantages. The main advantage of an (object-oriented) database is that it is easy to integrate into the program system. The disadvantages of databases are their performance level, which is often too low, their poor support of multidimensional fields (measurement series), and the fact that the customer must usually have the same database.

NetCDF (Network Common Data Form) originated in the United States under the national Unidata program, for which the Colorado-based National Science Foundation (NFS) is responsible. The aim is to make scientific data as portable and as simple as possible to manage. [passage omitted]

It is currently expected that, in view of its portability, the netCDF format will come into standard use for European scientific cooperation (ESPRIT [European Strategic Program for Research and Development in Information Technologies], BRITE-EURAM [Basic Research in Industrial Technologies for Europe/European Research on Advanced Materials], GARTEUR [Group for Aeronautical Research and Technology in Europe], ESA [European Space Agency], etc.), at least for data exchange between contractors.

Figure 5 [not reproduced] shows a typical screen scenario at the DeAs workstation.

By way of example, the windows in zone one show a very small part of the DeAs plant software: a description of (wind tunnel) plants. Zone two shows the main menu with of the Highend 3-D visual display tool output window. Zone three shows the "xvgr" 2-D visual display tool output window.

A full version of DeAs will be used for the first time at the TWG in 1994. In view of its open design, ease of expansion, good portability, and clear interfaces, a useful life of at least 10 years may be predicted, which is very long for a software product.

European Transonic Wind Tunnel Begins Operations in Cologne

93WS0517A Frankfurt/Main FRANKFURTER
ALLGEMEINE in German 8 Jun 93 pp T1-T2

[Report by Wolf-Heinrich Hucho: "Transonic Wind Tunnel: Sky of Fast Jet Brought Into Laboratory"—first paragraph is FRANKFURTER ALLGEMEINE introduction]

[Text] Europe is preserving its chances of success in the construction of commercial airliners. Cryotechnology is enabling engineers to work with 1:30 models.

Today the world's most up-to-date wind tunnel will be officially inaugurated in Cologne. The "European transonic wind tunnel," ETW for short, is to go into operation after a development and construction period of 10

years. France, Great Britain, the Netherlands, and Germany came together to construct it. With an investment of about DM660 million they have closed a gap that was hard for the aviation industry in the Old World to close. A similar installation exists only in the United States and it is closed to Europeans. Now Europe too will be able to fully simulate the flow of air around future commercial airliners with small models long before the first flight.

Aerodynamics engineers can, to be sure, predict the performance of an airplane with astonishing precision. But the computer is not going to replace the wind tunnel that quickly. They can still only ensure that the performance specifications for a plane will really be met by testing. If they forgo the wind tunnel experiment, they run the risk of having to make improvements on the prototype when the flight test is already in progress.

But this may cast doubt on the success of a DM10-billion project—that is how much it currently costs to develop a big commercial aircraft. Because delivery to the customer on schedule is just as important as meeting the guaranteed flight specifications. The early bird catches the worm. In its time Boeing impressively demonstrated the fact: When De Havilland was set back in the 1950's by the disastrous Comet production series, the Americans conquered the world market with the Boeing 707 and dominated it for decades.

What takes place in a wind tunnel and what is so special about the ETW? In a wind tunnel the movement sequence is reversed. While a real airplane flies through stationary air at high speed, its scaled-down model is held fast in the wind tunnel and blown at by a jet of air. This airstream is produced by a blower and—to conserve energy—guided into a closed cycle, a construction type that Ludwig Prandtl, the founder of modern aerodynamics, introduced as early as 1908 and which, in honor of the place where he conducted his research, is dubbed the "Goettingen" [wind tunnel].

The model of the aircraft to be developed should be as small as possible. Then it can be built faster and is easier to handle. And all that is needed to measure its capabilities is a wind tunnel. But in so doing, the laws of model mechanics need to be observed. Only then, when they are precisely observed, can the results of the test be applied to the full-scale version and only then are they safeguarded against—mostly unpleasant—surprises.

These model laws are easily formulated and difficult to adhere to. For one thing, the model has to be geometrically similar to the full-scale version. This is a job for a skillful model builder. But then "mechanical" similarity must also be guaranteed. This means that all decisive aerodynamic forces must be in the same proportion to one another in the model and the full-scale version. Then—and only then—do the flow lines assume the same shape in both cases. The shapes of the airstream are so closely related to one another in both cases that the only difference between the model and the full-scale version is the scale factor.

When a plane flies at a high subsonic speed, it is affected by three kinds of forces: inertia, friction, and elasticity forces. If they are suitably proportioned to one another, two laws of similarity can be derived from the fact. They can be expressed in terms of characteristic values that have been named after physicists Ernst Mach and Osborne Reynolds.

The Mach similarity law makes allowances for the elasticity forces, takes into account the fact that air is compressible. This law can be relatively simply adhered to in a wind tunnel since it does not affect the choice of the model scale. Only the ratio between two speeds, the speed of flight and the speed of sound, has to be the right one.

On the other hand, adherence to the Reynolds similarity law—through it the effects of friction are understood—creates difficulties. When the wind tunnel is operated with air under ambient pressure, according to Reynolds, the airstream speed must be increased to exactly the figure around which the model was scaled down vis-a-vis the desired full-scale version. In practice this has resulted in their having to work with very large models and, because of this, needing a huge wind tunnel. An example of this is the German-Dutch wind tunnel (DNW). But Mach 1 cannot be attained with it at cruising speed. That would require an astronomical power output. Only the comparatively slow speeds attained during takeoff and landing can be realistically reproduced.

The air density offers a way out of this dilemma. As it is increased, the gap in the amount of speed needed to attain the "real" Reynolds number can be bridged. There are two ways to achieve this goal. First wind tunnels were built that operate with increased pressure. But in the process a pressure of more than 5 bars proved to be impracticable. Because then the elastic deformations of the model become so great under wind conditions that it loses its geometrical similarity. So it was a blind alley. But it led to the idea that was finally realized in the ETW: The density of a gas can also be raised by cooling it. However, with this trick it took extremely low temperatures to attain the very high Reynolds numbers that were required. But the effort was worth it. The power output of the wind tunnel blower can even be reduced.

These low temperatures are attained when not air, but cryogenic—cooled to 170° C—nitrogen is used as the wind tunnel's operating medium (oxygen is already liquid at this temperature). Liquid nitrogen is continuously sprayed into the tube of the wind tunnel to compensate for the heat loss. Working with gas this cold requires mastery of a very special discipline, cryotechnology. Development and application of it to the concerns involved in a wind tunnel were rushed to completion by the German Aerospace Research Institute (DLR). Its engineers converted the regular wind tunnel in Cologne into a cryotunnel. In the process its concrete tube was provided with a new type of highly insulating layer. This idea of interior insulation was then applied to the ETW. Its tube is, of course, made of high-strength

steel because of the higher pressure, but it does not like high temperatures either; they make it brittle and fragile.

Introducing the liquid nitrogen into the tunnel and mixing it with the gas stream so that a homogeneous gas is delivered to the measured length posed another problem. It was necessary to build special injector nozzles and control valves that do not ice over. They as well as the blowoff technique were developed in the Cologne cryotunnel. However, they were able to get the appropriate industry to take care of all the details relating to the transport, storage, and handling of liquid nitrogen.

Unless one wants to spend valuable time in preparing the wind tunnel for operations, the model has to be cooled to the subsequent operating temperature beforehand. In the ETW the models are rigged at the ambient temperature. Three separate chambers are provided for this. Then the model and the test setup are driven through a big lock gate into one of the refrigerating chambers. In it the whole setup is tempered and tested on heart and kidneys at the subsequent operating temperature. It is only then that it goes into the measured length. At that point no more time has to be wasted there on the usual calibrations.

The models themselves are, to be sure, small—an Airbus A-310 attains a wingspan of 1.46 meters on a scale of 1:30—but at a cost of DM2 million very expensive. Because they are made of high-strength steel, have to be very precise, and have an ultrasmooth surface, but also because their "inner life" is very complicated. The instrument box, scales, and pressure and temperature sensors must be miniaturized and made resistant to extremely low temperatures.

First, a working model of the ETW on a scale of 1:8.8 was built—a task that was assumed by the Nationaal Lucht-en Ruimtevaartlaboratorium [National Aerospace Laboratory] (NLR), the Dutch counterpart of the DLR. All the details of the wind tunnel layout were checked out with this pilot tunnel. The actual construction of the ETW then took only 34 months. "Wind on" was ready by the end of 1992, after the queen had honored the tunnel with her visit, a gesture that underscores the profound commitment the British have to aerospace research.

Is there still anything at all left to be developed with respect to the form of modern jet aircraft? Don't they look almost unchanged since the introduction of the Boeing 707? Appearances are deceptive. With the Airbus A-340 (the four-jet, long-range version recently put into service), they have been able to reduce fuel consumption per flight mile by 60 percent as compared with the 707. Naturally, aerodynamics alone is not responsible for this. Engine technology, configuration, lightweight construction, and avionics are decisively involved in it. But aerodynamics is responsible for a substantial share in its success and its potential is not yet exhausted.

Improvement in their aerodynamics on the way from the 707 to the Airbus was in particular achieved with regard to the shape of the airfoil. Through new wing contours,

they succeeded in shifting the sharp increase in air resistance that appears even before approaching the sound barrier to higher Mach numbers. In so doing, it was possible to attain a higher cruising speed with the same resistance or—and this is what counts much more today—to consume less fuel at the same speed.

A further lowering of consumption is anticipated from the consistent application of laminar technology. About half the air resistance of an aircraft is produced by friction. Air particles adhere to the outer skin of the aircraft and are carried along with it. In the thin layer near the wall of the plane, the boundary layer, the speed of the air is reduced by the speed of the aircraft to the zero value of the stationary ambient. In the process, shear tensions are produced and they slow down the aircraft. There are two flow shapes in this boundary layer, a laminar and a turbulent one. With the former, the flow moves in well-ordered layers, hence the term "laminar." The shear stresses transmitted to the wall are small. In a turbulent boundary layer, on the other hand, the flow behaves in a chaotic manner and an intensive exchange of impulses is produced by powerful turbulence.

When we take a closer look at the flow in the boundary layer of an airfoil, we realize that it begins as a laminar flow at the leading edge, but then it very quickly becomes turbulent. But the spot where the change takes place may be affected by the shape of the airfoil and shifted toward the rear. Thus frictional drag is constantly reduced. This technology has been honed to perfection with gliders. Extension into the transonic range is, however, still an object of intensive research. The change from laminar to turbulent flow is one of the hardest problems of fluid mechanics to control. Prandtl-Schueler Tollmien and Schlichting did indeed formulate a mathematical approach to calculation of the sudden change as early as in the 1930's, but their theory still leaves many questions about transonic speeds unanswered. These can only be answered with the wind tunnel, under precisely simulated flight conditions. This is what the ETW provides.

German Aerospace Airbus, Ltd., and the DLR have assumed a leading role in laminar technology. They have succeeded in proving that the boundary layer can be kept laminar over long distances on a swept-back wing too. This occurs if the air particles are sucked into the interior of the wing, a trick known since the 1940's, but which they have only now gotten round to applying [to this problem] on a trial basis. With engine nacelles getting to be "thicker and thicker," this can even be achieved just by contouring their outer skin. In short, a reduction of air resistance of about 15 percent is anticipated for the Airbus with consistent laminarization. Since the cost of fuel accounts for 10 percent of direct operating costs (DOC), this leads to a lowering of costs of about 1.5 percent.

Not much? Oh yes it is, since such differences today decide whether an airline is in the black or in the red, whether a new aircraft will be a success or a flop.

France Developing Space Water-Treatment Systems

93WS0513A Paris L'USINE NOUVELLE
TECHNOLOGIES in French 20 May 93 pp 13-14

[Article by Isabelle Seel: "Recycled Water for the Columbus Laboratory"; first paragraph is L'USINE NOUVELLE TECHNOLOGIES introduction]

[Text] Scientists are devising a process for nearly 100-percent retreatment of water that totally eliminates bacteria, filters salt and organic molecules, polishes the water, and treats it with UVs.

Anjou Recherche, the General Water-OTV Company's research and development consortium, is giving the public a peek at the first technological demonstrator for the treatment of space-laboratory waste water. The event is a big international first, since even on earth, waste water has so far been diluted and discharged into sewage systems.

The 3.4-billion French franc [Fr] program is the brainchild of the ESA and part of the Columbus orbital station program. France's Orbitics, which specializes in transferring technologies to the space industry, and Denmark's counterpart to the General Water Company, I. Kruger AS, are collaborating. The GWC-OTV could become the top supplier of space water from the outset.

"The high cost of space transport, which runs about Fr250,000 to 350,000 per kilo, warrants water recycling," points out Marie-Marguerite Bourbigot, project head and director of Anjou Recherche-OTV. Columbus's Biolab will conduct experiments on microgravity, food production, and the synthesis of medicines, among other areas. "The challenge with space water is to treat highly-loaded, variable effluents using processes that are still experimental even for the treatment of natural water," stresses Catherine Moulin, research engineer in charge of testing.

Anjou Recherche began by defining the various quality levels of laboratory water needed: level 1 for distilled cleaning water; level 2 for the culture of algae or bacteria; and level 3 for ultra-pure water intended primarily for crystallography. Then the firm designed a wholly original configuration, that may use membranes to purify laboratory water for the first time ever. Step one in the process, micro- or ultra-filtering, aims to eliminate all bacteria. Researchers are still hesitating between nanofiltration and reverse osmosis for the second step. Both seek to create a maximum barrier against salts and organic molecules, but reverse osmosis filters the water very finely. However, it requires the use of much higher pressures—from 25 to 60 bars, compared to 5 to 10 bars for nanofiltration—making the choice of pumps and

pump size problematic. In the third step, columns containing mixed beds of activated carbon (which eliminates residual organic molecules) and ion-exchanging resins (which block metals) "polish" the water. Ultraviolet treatment improves the results to produce extremely pure water.

The consortium will initially test the future space process on a technological demonstrator that is still being built. The demonstrator will validate or invalidate the technologies selected, and size the surface of the membranes, which will have to function 100 days without cleaning or any other adjustment.

The process will deliver water only on request (an average of 10 liters a day). But membranes have a low tolerance for interrupted operation, which exposes them to contamination. Biocide will have to be injected into the process during functional breaks. Anjou Recherche also aims to achieve a nearly 100-percent conversion rate: that is, recycling of nearly all the water the system treats.

For now, Hydrex, the industrial designer for the membrane systems, is optimizing the layout of the demonstrator's components. It has devised an approximately 1-cubic-meter pilot that contains the treatment devices and four vats for testing the different phases. A group of ABB sensors will assess water purity, temperature, cloudiness, etc. through conductivity measures. As for the automatic control driving the system, it is derived from simple washing-machines!

Once aboard the Columbus, the purification station will have to be more compact and free of its electronic artillery. But in addition to miniaturization problems, engineers must still decide between a single system and several small, decentralized stations, to prevent contamination or chemical reactions. Anjou Recherche plans to run the first tests at its facilities this spring, but the first modules will take flight in 1998. The sooner the better!

Eutelsat May Abandon Europesat

93WS0527A Paris AFP SCIENCES in French 27 May 93
p 6

[Unattributed article: "Rumored Abandonment of Europesat Program"]

[Text] Paris—The European satellite broadcasting project, Europesat, might be abandoned, at the initiative of Deutsche Telekom, which was the largest participant next to France Telecom, we learned in European telecommunications circles.

As yet, the Eutelsat organization, author of the project, has not notified any decision to the project prime contractor, the French group Matra [Mechanics, Aviation, and Traction Company], but France Telecom does not conceal that the project is already considered as "put on the backburner, although not necessarily killed."

Some see the possible abandonment of this satellite, worth 600 million French francs [Fr] and scheduled to be put into orbit late in 1994, as the direct result of the emergence of digital (television and radio) broadcasting, which provides better sound and image quality than the D2-MAC standard that "fell through" in Brussels last week.

Europesat was viewed as a transition satellite. As experts point out, there is no longer any reason to build it if digital broadcasting continues to progress at the current rate.

Because of problems encountered on one of the two TVSat direct television satellites soon after it was launched, Germany looked for an alternate solution. Thus, the Europesat project was born; it was presented by Eutelsat and supported—without enthusiasm, in the name of Paris-Bonn cooperation—by France Telecom, which was in a strong position with its two TDF-1 and TDF-2 satellites and Telecom-1 and Telecom-2 series satellites.

During all these years, the French and the Germans were never on the same wavelength with respect to Europesat, specialized circles acknowledge. "We were only minority participants in the project," a France Telecom spokesman said. "We always said that if we found clients to 'board' that satellite, we would support it; it did not happen." It is true that the French public operator had to find a clientele for its Telecom-2 satellite channels, "which is now done. Our satellites are full. We shall launch Telecom-2C in 1995," the spokesman added, hinting that they might consider ordering a fourth Telecom-2.

For the Matra group, which is ready to build this fourth Telecom-2, the possible abandonment of Europesat would represent a considerable loss of earnings. Europesat definition studies are completed and Matra expected to go over the construction stage, "which would require 24 to 26 months." Nevertheless, if the decision were confirmed, it would not diminish the group's determination to work together with German manufacturers, one of whom, ANT Bosch, was a partner in the project.

German-American Cooperation Successful on D-2 Mission

93WS0529A Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 25 May 93 p 8

[Unattributed article: "Space Research: German-U.S. D2 Mission Appears to Be Complete Success: First Stock-Taking Shows Highly Interesting Results; New Diagnosis Method Possible; 40 Tests With Metal, Salt, and Glass Meltings"]

[Text] Frankfurt—The many thousands of scientists and engineers involved in the latest Spacelab flight are extremely satisfied with the course of the flight and its first discernable results; however, thoroughly evaluating the numerous experiments will take a considerable amount of

time. The D2 mission was the most complex and demanding Spacelab mission to date. It involved 88 tests in 11 areas of research (communication, astronomy, earth observation, radio-biophysics, surface stability, automation and robotics, mechanics, fluid physics, solidification and crystallization technology, biology, and physiology). However, there were also various technical glitches and scientific failures.

The first seven areas were actually independent of gravitation, while the other four were purely zero-gravity experiments. However, all the experiments were possible only under the special conditions of near-earth orbit. The greatest attention was given to the numerous human physiology experiments in which the astronauts studied themselves. With the Anthrorack, resembling a mini-clinic, the men studied primarily their heart and lung functions, as well as the fluid displacement in their bodies under zero gravity.

One particular finding in the area of respiration was that the textbook assertion concerning the irregular passage of air through the lungs under normal earth gravity is no longer tenable. Measurements of the heart's volume capacity during physical exertion showed that zero gravity apparently does not cause the expected reduction in capacity.

Another interesting finding from the Anthrorack experiments came from the spontaneous use of a sensor otherwise used for microgravity measurements in Spacelab as a heartbeat meter, which also permits conclusions concerning the volume of blood transported. Through this, a new diagnosis method could perhaps be introduced for patients on earth, and the heart catheter, which is not without risks, could be rendered unnecessary in certain cases.

On the whole, the Anthrorack experiments during the D2 space mission was highly significant for everyday earth medicine as well. Many of the devices developed for Spacelab use will soon be available in a similar form in our hospitals and specialized stores. These include, for example, the self-tonometer for measuring internal eye pressure, a preventive examination to avoid glaucoma.

Moreover, the edemometer developed for the astronauts to measure tissue fluid (water in the legs) and a glucose tolerance test (diabetes) are currently being adapted for clinical applications. In the latter case, the Spacelab test should show new ways to prevent or treat diabetes by clarifying why sugar is transported to the cells by the blood much more slowly in bed-ridden people.

Other experiments confirm observations of previous crews of astronauts, according to which significantly fewer antibodies are formed in the human mechanism under zero gravity. These T-lymphocytes play a key role in the immune system. "Perhaps decoding the mechanisms that lower the immune response in zero gravity will help explain why the body cannot protect itself against certain pathogens," explains Dr. Kuklinski of the

Institute for Flight Medicine of the DLR [German Aerospace Research Institute] in Cologne.

Various failures occurred with certain other biological tests on board Spacelab. For example, several fish and tadpoles died for unexplained reasons. In contrast, the brewer's yeast experiment, in which the reaction of these fungi to cosmic radiation was studied, was a success. Even slight changes in the genetic structure of yeast can significantly alter the taste and odor of beer brewed with it. This was one of the few Spacelab D2 experiments to which German industry contributed.

A major role was played by fluid physics, with paraffin oil at normal temperatures and with metal and silicon meltings at very high temperatures. After evaluating similar tests from the D1-mission eight years ago, it was questionable whether the theoretically expected "singularity" of certain thermophysical data had to occur at the critical point. These measurements from the D2 did not confirm the supposed new effect, however.

The experiments on numerous liquid columns were also a resounding success. For example, the goal of the experiment by Korean C.H. Chun of Goettingen was to determine the physical processes during so-called Marangoni convection. This type of current at liquid surfaces occurs in zero gravity.

With a new television camera specially developed for this mission, the "stretching" of the liquid columns and their vibration behavior were optically documented. At the same time, precision sensors in the mechanism plates registered the alternating pressure at both ends. With these data, which can be obtained only in zero gravity, effects during crystal growth and solidification processes in liquids can be better understood.

The D2 mission included approximately 40 experiments with metal, salt, and glass meltings that are not possible on earth under normal gravity. Particular attention was given to the mono-test, in which new materials for friction bearings were tested. In addition, it was possible to grow a 20 cm gallium arsenide crystal, the largest ever in a zero gravity experiment.

There was impressive use of the rotex manipulator, which performed all planned tasks and safely moved the components of a particular experiment from one position to another. The high point here was the capture of a free-floating object by the claw arm, which underscored the extraordinary sensory, mechanical, and electronic quality of the mini-robot.

Also very important are the measurements from the mechanics experiment to register the slightest vibrations caused by the systems and astronauts that influence the quality of the microgravitation. In critical cases, the time correlation helps in the evaluation of test results.

Also successful were several telescience experiments in which the orbit tests were directly controlled from the ground station. This is a considerable contribution to the

further automation of space travel, Prof. Bernd Feuerbacher of the DLR believes. The biology experiments included successful tests of electro-cell fusion on the tobacco plant, foxglove, and sunflower. Further insight of importance to bioengineering is expected here.

The Moms-02 earth surveillance camera also functioned very successfully. The Modular Optoelectronic Scanner recorded earth surfaces with a resolution of 5 meters from an altitude of 300 km. Under a UN mandate, large areas of Cambodia were recorded in order to allow a precise determination of the borders there as preparation for the peace process. Astronomers are satisfied with the performance of the Gauss camera (University of Bochum), which took over 100 pictures of the Milky Way in UV light, as well as images of the earth's atmosphere in the same spectral range.

Detailed evaluation of the complicated experiments will take several months longer. The final report should be ready in a year. However, the nearly 10 years of preparation have already yielded some interesting results. Among the researcher groups, approximately 100 doctoral dissertations, 200 postgraduate dissertations, and 400 theses have already been written at colleges on the D2 experiments. The coming evaluation of the experiments will probably bring with it an even greater scientific yield.

Germany: VSAT Communications Satellite Assimilated

93WS0529B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 1 Jun 93 p 10

[Unattributed article: "1,900 Satellite Systems for VSAT: Bundespost Falls in Line with International Trends in Fees"]

[Text] Munich—Ever since German Bundespost Telekom began approving private suppliers of telecommunications services via satellite in June 1990, 33 licensees with 1,900 systems have taken advantage of the opportunity. Internationally, these systems are called "Very Small Aperture Terminals," or VSAT, because they operate with small reflectors. The application covers all branches of telecommunications. Companies with a network of branch offices have used these installations extensively ever since the individual ground stations became inexpensive and it became possible to professionally control the distribution service from central ground communication stations (teleports).

On 1 May of this year, the Bundespost lowered the fees for this considerably, or in some cases eliminated them entirely. Small satellite receiver systems now operate free of charge. For stations that perform both transmission and reception, only 1,000 German marks [DM] (previously DM1,900) are charged in the first year, and after 2 January the fee is only DM100 (previously DM1,900). In this way, the Bundespost is falling in line with international trends in fees, now assuming a position "in the medium range," according to its own assessment.

This means that equal opportunities for private VSAT operators and German Bundespost Telekom have been achieved: Both groups pay the same fees to the Federal Ministry for Post & Telecommunications. Only their designations are different. What Telekom pays are frequency usage fees, while private operators are subject to licensing fees.

Germany: Strategy for Mars Research

93WS0529C Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 24 May 93

[GERMAN PRESS AGENCY report: "Strategy for Mars Research"]

[Text] Washington—An international working group from the United States and Europe wants to develop a joint strategy for studying the planet Mars after the year 2000. The U.S. space agency NASA has announced that this project will involve, besides NASA, the European Space Agency (ESA), and the space agencies of Italy, France, and Germany. The working group was set up recently in Wiesbaden. The first meeting is planned for October in Graz, Austria.

ESA Launcher Technology Program Evaluated

BR2307085893 Paris REACHING FOR THE SKIES
in English Jun 93 pp 11-12

[Article by J.-F. Lieberherr: "ELITE Under Way"]

[Excerpts] The ELITE activity was presented in this bulletin two years ago as an effort to coordinate European activities in launcher technology, to increase the cooperation between all the countries interested in launcher activities, and to provide a forum for discussing technological issues with interested industries and research organisations. Although the available means are very modest, the idea is now proving fruitful and several contracts are under way, following more or less closely the planned ELITE guidelines. [passage omitted]

ESTEC [European Space Research and Technology Center] was given the responsibility of managing the ELITE contracts within the Technology Research Program (TRP) while cooperating with the Space Transportation Directorate when defining the aims of the studies. This cooperative aspect of ELITE goes beyond a coordination within ESA since the ELITE areas of work have also been discussed with industry and national authorities, during specific presentations and technical discussions and seminars. Two years after the formal start of ELITE it is time to examine the results that have been achieved.

Technical Results

The technical work has not covered all the areas initially foreseen, and the practical needs have led to the effort being concentrated in mainly two areas: tribology and

vibration-related phenomena. Materials have also been addressed, however, in a broader context. In tribology there was a certain overlap between what ESA had planned and what CNES [(French) National Center for Space Research] was actually carrying out. Some coordination between ESTEC and CNES was therefore necessary. Coordination meetings started in November, 1989, and are presently continuing at the rate of one a year. Coordination with other nationalities took the form of a contract to BHRA (British Hydraulics Research Association) in March, 1989, with a view to understanding the conditions under which face seals can fail. The purpose was to go beyond the experimental solutions that had given satisfaction. The role of friction in particular was to be investigated. Seals of this type are used on the HM7 turbopumps and on the Vulcain LOx turbopump. This study has therefore raised interest in the relevant industrial firms (SEP [European Propulsion Company] and Fiat-Avio). At present a model for the operation of a seal has been defined, and is to be developed and validated experimentally in a follow-up phase.

Cryogenic Bearings

The initial purpose of the study was to investigate the thermal behaviour of bearings cooled by liquid hydrogen and to explain the temperature peaks that were observed on such bearings. Although experiments showed that the peaks could be eliminated by adequate lubrication, the question still remained whether we understood this lubricating mechanism sufficiently well to explain its effectiveness. From discussions with several companies or organisations, we found widely diverging views on the subject. We are in the process of resolving the differences in opinion.

Valve Tribology

This task was started in August, 1991, and was planned to end in February 1993. It represents a good example of how ESA sees the ELITE activities. The purpose is to identify and quantify the mechanisms that come into play in low-speed valves, in particular how friction coefficients are influenced by the nature and the processing of the materials and how friction coefficients are linked to operational torque and to leak-tightness. This contract is with FN-Moteurs [National Factory-Engines] in Belgium, in cooperation with SEP. The choice of the contractor and of the topic is linked to the role played by FN-Moteurs in the development and production of the valves for Ariane-5. The funding of this activity is shared between ESA, FN-Moteurs, and the Walloon regional government of Belgium.

Tribometer

The purpose of this activity is to analyse the possible reasons for the wide disparity found in the literature on measured friction coefficients and to determine whether the present definition and measurement techniques of friction coefficients are adequate and, if needed, to

propose improved definitions and measurement techniques. Work has started at the European Space Tribology Laboratory at Risley, UK, and is expected to be completed in 1993, leading possibly to a design for an improved tribometer.

Advanced Materials

There is no specific contract on materials and therefore this is not really an ELITE activity, but it is an ELITE contribution to the ESTEC research in materials. Due to the importance of the subject for ongoing developments, the Ariane Project Directorate of CNES is associated with the definition of the objectives. This activity is mainly carried out with Fulmer. The objective is to identify candidate materials for lighter-weight rocket chambers, compared to the present copper-based designs. After a few initial hopes for a positive outcome, the findings have turned out to be negative, but new possibilities have been identified recently.

Rotor Dynamics

This contract was awarded in August, 1989, to the University of Liege [Belgium], with subcontracts to Samtech and SEP. Its purpose is to propose a way to derive from experimental data on turbo-machines, the difficult-to-measure characteristics of the rotor and of its housing (stiffness, damping, fluid forces). A model doing this has been developed and is being validated on a simplified test rig at Liege. A more complete validation is in the planning stages.

Vibroacoustics

This activity is aimed at improving and simplifying the methods for predicting the acoustic loads on a satellite under a fairing, when given a description of the field outside the fairing. This activity is well coordinated with CNES, which provides ESA with the definition of the field outside the fairing. The holder of the contract is Dornier, in cooperation with the Institut Universitaire de Technologie of Compiegne and the Swedish Institute for Aeronautical Research (FFA). From this activity a certain number of analytical tools were expected to be used in the preparation of satellite launches. This task was completed in September 1992.

Nozzle Aerodynamics

The problem underlying this activity was identified in cooperation with CNES on account of its potential for upgrading the performance of the Vulcain nozzle. A first problem is to define to what extent a nozzle can be lengthened without undergoing flow separation under sea-level conditions, and according to its design, whether there are designs that retard flow separation or keep it symmetrical. Another objective is to find a design for a turbine exhaust port, downstream of a nozzle throat, to inject the gases into the main stream in an optimal way (performance and cooling). Work is going on.

The Future

The future will see first the completion of the tasks under way. Certain tasks have met some difficulties or delays and it has to be decided whether they have to be interrupted in their present state, or whether they should be continued until a satisfactory milestone is reached.

New tasks will have to be introduced soon to replace those that have been completed. Their content should be discussed with our European partners at the earliest convenience. The interfacing of ELITE with FESTIP [Future European Space and Transportation Program] and with GSTP has also been prepared.

Experiments on Eureka Platform Described

BR2707145193 Noordwijk MICROGRAVITY NEWS
FROM ESA in English Jun 93 pp 17-26

[Article by O. Minster of the ESA's European Space Research and Technology Center in Noordwijk, the Netherlands: "Microgravity, Space and Technology Experiments Onboard EURECA"; all numbers in chemical compounds are subscript unless otherwise stated]

[Text] The European Retrievable Carrier, Eureka, has been primarily designed to enable scientists to carry out long-duration experiments under accurately controlled microgravity conditions.

The core payload of Eureka was developed by industry under ESA contracts managed by the Microgravity Division of ESTEC [European Space Research and Technology Center] and includes the following multi-user facilities:

- the Automatic Mirror Furnace (AMF),
- the Multi Furnace Assembly (MFA),
- the Solution Growth Facility (SGF),
- the Protein Crystallisation Facility (PCF),
- the Exobiology and Radiation Assembly (ERA).

In addition to the core payload, two stand-alone instruments were provided by national space agencies: the High-Precision Thermostat (HPT) from Germany and the Surface Forces and Adhesion Instrument (SFA) from Italy.

Eureka was released from the space shuttle Atlantis by ESA astronaut and mission specialist Claude Nicollier (flight STS-46) in August 1992. It then used its own propulsion system to transfer to the operational orbit at 508 km altitude. After commissioning, payload operations started and experiments were performed over the six months of the operational phase. The experimental programme with the core payload could be completed successfully by the end of February, 1993, and the

facilities were essentially deactivated during the subsequent dormant phase. The HPT and the SFA instruments were still operated until the orbit change manoeuvres were started for the retrieval, thereby taking maximum advantage of the microgravity environment to get valuable scientific data.

A Microgravity Measurement System including several accelerometers located at different points on the spacecraft permitted continuous monitoring of the residual accelerations. The performance of the spacecraft and its payload in terms of perturbation to the experiments were outstanding and the specifications were largely attained. The residual accelerations recorded hardly 10-6g0 [as published] over the whole frequency spectrum.

The experiments performed in the core payload benefited from the efficient support of a dedicated team located at the Microgravity User Support Centre, Cologne (Germany). After having participated in their preparation, the team monitored the experiments during the operational phase and acted as an interface between the investigators and ESOC [European Space Operations Center], from where the spacecraft and its payload were controlled.

The main fields of microgravity research addressed during the Eureca mission are as follows:

- mass transport by diffusion in liquids,
- crystal growth of electronic materials,
- crystal growth from low-temperature solutions,
- crystal growth of biological macromolecules,
- liquid-phase sintering of composites,
- wetting behaviour in metallic immiscible systems.

The scientific background and a short description of the experiments are given in the following, as well as some preliminary results. In most cases, however, the scientific outcome of the experiments will be known only after a thorough analysis of the samples and the data will have been performed.

Mass Transport by Diffusion in Liquids

Experimental measurements of mass transport by diffusion in liquids are extremely difficult to perform on the ground with the required accuracy due to the unavoidable contribution of buoyancy convection to the mass transport process.

Thermomdiffusion, also called Soret effect, occurs in mixtures, including mixtures of isotopes, submitted to a temperature gradient. This effect leads to the segregation of the different species according to their density. The Soret coefficient, which is the ratio of the thermal to the isothermal diffusion coefficient, is defined positive if the denser component migrates towards the cold side. This effect occurs in all three states of the matter, but is obviously greatest in gases.

In the Multi-Zone Furnace of the MFA, Dr. J. P. Praizey, CEN [Nuclear Research Center] Grenoble, conducted experiments on thermomdiffusion in alloys and pure metals. A shear-cell was used which accommodates four samples (two samples of Au-Sn and two samples of Sn only, for isotopic separation). After 10 days, when the steady state was reached, the shearing mechanism was activated and each sample, still in the liquid state, was divided in several sections and then solidified. The relative concentrations in each section will be measured on the ground.

A similar investigation was performed by Prof. J. C. Legros, Universite Libre de Bruxelles (Belgium), with various binary organic mixtures and aqueous electrolyte solutions. The experiment is accommodated in a dedicated SGF container housing 20 tubes with a volume of less than 10 ml for 8 cm in length. In microgravity, a temperature difference of 8°C was imposed between the two ends of the tubes. One of the tubes filled with an aqueous solution of silver nitrate is equipped with electrodes which allowed to follow in real time the evolution of the concentration gradient. Before the end of the microgravity period, a liquid sample of about 1 ml was isolated at both extremities of all tubes for further analysis on the ground.

The objective of the experiment performed by Dr. L. Ratke, Institute for Space Simulation, DLR [German Aerospace Research Establishment] Cologne, is to improve the understanding of interfacial phenomena in liquid alloys by studying diffusion phenomena such as Ostwald ripening in immiscible metallic liquids. The analysis of the samples will enable to determine interfacial energies and diffusion coefficients at various temperatures and for different compositions. Such data are essential for the theoretical modelling of the solidification of monotectic alloys. On Eureca, the planned temperature/time profiles were successfully achieved in three isothermal furnaces TEM01 of the MFA and nine samples of Al-Pb alloys of different compositions were processed.

Crystal Growth of Electronic Materials

Gravity has a significant influence on the quality of crystals as the fluid phase, be it liquid or gaseous, from which they are grown is the seat of buoyancy convection flows which make heat and mass transport conditions during the growth process quite complex. Convection acts at a macroscopic scale as it redistributes permanently in the fluid phase the doping species segregated at the growing interface. This leads to a continuous change of the macroscopic dopant concentration and thereby to non-uniform properties along the longitudinal axis of the crystal. At a microscopic scale, gravity-driven unsteady convection flows in the fluid provoke temperature fluctuations at the growing interface and thereby striations in the crystal.

In microgravity, heat and mass transport occur by diffusion only and can therefore be much better controlled.

By comparing space and ground experiments, one can establish a clear distinction between gravity-dependent and gravity-independent inhomogeneities and defects. Moreover, experimentation under microgravity conditions is the only means of studying fundamental phenomena in crystal growth which are masked on the ground by the influence of gravity.

Growth From Metallic Solutions

Metallic solution growth of electronic materials has some major advantages over melt growth methods:

- the vapour pressure is low or negligible due to the lower growth temperature;
- lower contamination of the solution by the ampoule or the crucible material;
- the lower growth temperature reduces the deviation from stoichiometry for purely thermodynamic reasons, which result in more perfect crystals.

The AMF facility is particularly suitable for the crystal growth from metallic solutions using the Travelling Heater Method (THM). With this technique, the material is transported from a source to a seed via a metallic solvent. The solvent is placed in the growth ampoule between the source and the seed. The process consists of melting the solvent zone located at the focus of the ellipsoidal mirror of the AMF and pulling the ampoule so that the focus moves away from the seed. The shift of the temperature profile provokes the precipitation of the material on the seed and, simultaneously, the dissolution of the source into the solvent. The difference in solute concentration across the solvent provokes solute transport which, in the absence of buoyancy convection, is driven by diffusion only.

In total, 13 THM growth experiments were performed in the AMF. Six were concerned with CdTe samples in a coordinated investigation between Prof. R. Nitsche and Prof. K. W. Benz, University of Freiburg (four samples) and Dr. J. C. Launay, PRAME [Acquitaine Research Center for Materials Development in Space] Bordeaux (two samples). Prof. R. Nitsche and Prof. K. W. Benz also conducted experiments with two samples of InP and two of GaInSb. Dr. R. Dornhaus, Battelle Institute, Frankfurt, has grown three crystals of PbSnTe and Prof. V. H. Kraemer, University of Freiburg, two crystals of the ternary sulphide with chalcopyrite structure AgGaS₂.

Crystal Growth From the Vapour Phase

Crystals can be grown from a vapour phase by physical vapour transport (PVT) or chemical vapour transport (CVT). With these techniques, material transport from the source to the seed occurs via the gas phase. On earth, gravity-driven convection in the gas phase degrades the quality of the crystals in terms of chemical inhomogeneities and crystalline defects. Prof. R. Nitsche and Prof. K. Benz, Freiburg University, grew two crystals of CdTe

and two of CdSe in the AMF. Both PVT and CVT were implemented with each material. Three vapour growth experiments were also performed by Dr. J.C. Launay, PRAME, in multi-zone furnaces of the MFA. The PVT method was applied to grow two crystals of Pb_{1-x}Sn_xTe and the CVT technique was implemented to grow a crystal of GaAs using a half sphere of monocrystalline AsGa as a seed.

Crucible Dewetting in Bridgman Growth

Semiconductor crystals grown in space in a Bridgman configuration do not always adopt the morphology of the inner wall of the crucible. Dr. T. Duffar, CEN Grenoble, proposed a model which predicts the separation of the crystal from the crucible when the crucible surface is distinctly rough and the wetting angle of the melt on the crucible material is large. In microgravity where the hydrostatic pressure is virtually eliminated and capillary forces dominate, dewetting is obviously favoured. Such a behaviour is of particular benefit as it reduces the chemical contamination by the crucible material, the thermal contact between the melt and the crucible and, eventually, the mechanical constraints by the crucible during cooling. Both the theoretical and the practical aspects of the dewetting phenomenon will be investigated by Dr. Duffar with the two samples of GaSb and GaSb-InSb (99 percent/1 percent), which were processed in the AMF.

Crystal Growth From Low-Temperature Solutions

This technique presents the great advantage of avoiding thermal stresses in crystals during after-growth cooling. It is also the only means of crystallizing thermally unstable materials. The classical "double diffusion" technique was implemented in three growth reactors accommodated on the SGF. In each reactor, two solutions of the two chemical constituents were initially isolated and, in microgravity, allowed to diffuse into a chamber filled only with solvent. When the two diffusion fronts met, the chemical reaction led to the progressive precipitation and crystallisation of the product. With free solutions on earth, this method is strongly disturbed by gravity, as density differences due to concentration gradients generate convection flows which perturb the concentration field. Crystalline nuclei also tend to sediment and multiple nucleation occurs so that a polycrystalline powder is obtained instead of a single crystal.

Two SGF reactors were employed by Prof. H. E. Lundager Madsen, Royal Veterinary and Agricultural University of Denmark, to grow calcium carbonate crystals and to study the formation of amorphous tricalcium phosphate under microgravity. Calcium carbonate has useful optical properties and is of interest in basic research on crystal growth in the bio-environment as large, highly perfect single crystal. Amorphous tricalcium phosphate (ACP) is a frequent precursor to crystalline calcium phosphates when precipitation occurs in an approximately neutral solution. It is formed immediately or

shortly after the ion activity product of tricalcium phosphate exceeds a certain critical value which is temperature dependent. Some hours later, in the absence of stabilising substances, one can find in the precipitate crystals of different types depending on the initial concentrations, the pH and the temperature. It is generally assumed that ACP is also a precursor in the mineralisation of vertebrate hard tissue and in the formation of apatitic urinary calculi. The experiment performed in the third reactor of the SGF by Dr. M. Stocker of the Centre for Industrial Research of Oslo, Norway, aims at obtaining large single crystals of offretite.

The offretite-erionite series of zeolites are candidate catalysts for industrial processes. Zeolites were used as heterogeneous catalysts in many technical processes such as catalytic cracking and the methanol-to-gasoline process. Their importance as catalysts is mainly related to their special properties such as their cation exchangeability and their shape selectivity due to a well defined pore structure. Studies on single crystals would provide a better basis for the design of zeolites and thus result in more active and selective catalysts. On earth, however, synthetic zeolite crystals are grown in aqueous gels where a large number of single crystals usually nucleate, thereby limiting the size of individual crystals. Large offretite crystals are expected to have grown in microgravity, and should present a reduced density of point, line, and plane defects as well as a reduced surface roughness compared with crystals produced on earth. Such a "perfect" material would be a valuable reference substance for testing the catalytic properties of zeolites and for the design of industrially relevant catalysts.

Crystal Growth of Biological Macromolecules

Biological macromolecules play a decisive role in all vital processes. The largest group is formed by proteins. Proteins are the basis of every process that takes place in a cell and knowledge of their three-dimensional structure is the only way to understand their molecular functioning. Presently, such information is available of only a small fraction of all identified proteins. Since they have such a wide variety of functions within a cell, they are the target for most drugs. If the target protein of an active substance and the three-dimensional structure of this protein were known, it would be possible to design drugs which would be readily recognised by this macromolecule and which, therefore, would have an optimum effect. And perhaps equally important: The structural model of the protein involved can be used to judge which derivatives of a potentially active substance do not need to be tested, since they will not fit in the binding site. Time consuming and expensive synthesis work can be saved in this way. Modern drug design, therefore, requires the knowledge of protein structures.

X-ray diffraction of macromolecule crystals is the most accurate method of determining their structure. With appropriate crystal quality, the position of the atoms can be determined with an accuracy of between 0.1 and 0.2 Angstroms. Unfortunately, protein crystals do not grow

to order. It is a trial and error process which is influenced by many factors. A general rule is that crystals should grow as undisturbed as possible. On earth, the growth is disturbed by gravity-driven flows of solution around the crystal and the sedimentation of growing crystals accompanied by the formation of clusters and aggregates. A number of space experiments were already performed during Spacelab and sounding rocket flights which produced, in some instances, significantly better crystals than ever before on the ground.

The 12 chambers of the PCF on Eureca were used by five investigators to grow crystals of different proteins:

- Complexes between aminoacyl-tRNA synthetase and native tRNA or tRNA produced in vitro (Dr. R. Giege, IBMC-CNRS [Molecular and Cellular Biology Institute of the National Center for Scientific Research] Strasbourg, France)
- Lysozyme and Beta-galactosidase (Dr. W. Littke, University of Freiburg, Germany)
- Rhodopsin (Dr. W.J. de Grip, University Nijmegen, the Netherlands)
- Alpha-crustacyanin (Dr. P.F. Zagalsky, Royal Holloway College, Surrey, UK)
- Bacteriorhodopsin (Dr. G. Wagner, Justus Liebig University, Giessen, Germany)

Protein crystals were clearly visible on the video images of a number of the PCF reactors but their quality has become questionable after an unintended transient warming occurred in all 12 reactors.

Liquid-Phase Sintering of Composites

The structure and homogeneity of composites manufactured by liquid phase processing techniques can be influenced by gravity as convection and sedimentation may lead to the agglomeration or separation of the second phase inclusions. The manufacturing process of WC-Co hard metals by powder metallurgy routes includes liquid phase sintering. On earth, when the mass fraction of Co exceeds 25 percent, the samples deform under their own weight during sintering ("jumbo foot"), or the microstructure becomes inhomogeneous. Furthermore, the WC particles are not evenly distributed and isolated from each other but rather form a skeleton. Current theory predicts that a minimum rate of contact formation between particles can be attained by decreasing their size to a point where the sedimentation effects are significantly decreased and the Brownian motion effects are not yet predominant. However, experiments carried out on the ground yielded samples with pronounced connections between the particles. Dr. W. Graf, Krupp Pulvermetall GmbH, Germany, expects to confirm the theory by observing in microgravity, i.e., in the absence of sedimentation effects, a dependency of the degree of dispersion on the particle size opposite to that observed on the ground. Nine samples of WC-Co

with different particle sizes were sintered as planned over different durations in three isothermal furnaces TEM-01 of the MFA.

Wetting Behaviour of Metallic Immiscible Systems

The monotectic reaction which occurs during cooling of systems presenting a miscibility gap in the liquid phase is greatly influenced by the morphology of the interface between the two immiscible liquids as well as their behaviour at the triple junction between the two liquids and the container wall (wetting angle and spreading coefficient). Experimental studies of the influence of the container material are performed with samples where, at a temperature just above the monotectic point, a bridge of one liquid is stabilised between two ceramic plates in the second immiscible liquid phase. After quenching the sample, the liquid-liquid and solid-liquid interfaces are examined and chemical interactions and diffusion phenomena along and across the boundary layers are studied. In microgravity the central liquid bridge remains stable at higher length-to-diameter ratios than on earth. A model was proposed to predict the ratio corresponding to the stability limit in microgravity in the case of immiscible liquid metals and one of the aims of the experiment is to verify this model with samples of Al-In and Zn-Bi and ceramic plates made of Al₂O₃, SiO₂, SiC, AlN, Si₃N₄, and vitreous carbon. In addition, even if, from a purely thermodynamic point of view, the contact angle between the phases at equilibrium does not depend on gravity, unexpected phenomena, such as creeping of liquids along ceramic walls, and variations in the spreading kinetics when capillary forces become predominant, were detected during former microgravity experiments. This experiment, performed in an isothermal furnace in the MFA, had been specially conceived with the purpose of gaining a deeper insight into such phenomena.

Adsorption Near the Critical Point

Physical adsorption of fluids at solid surfaces and in narrow pores is of importance in several fields of chemical engineering and applied technology. There is a marked difference in the adsorption behaviour at temperatures well below the gas/liquid critical point where the fluid exhibits multilayer adsorption and pore condensation near its saturation pressure, and adsorption of supercritical fluids at elevated pressures and temperatures well above the critical point. Therefore, a better understanding of the adsorption behaviour of near-critical fluids is of central importance for a unified description of their physisorption behaviour. Experimental studies of the thermophysical properties of fluids in their critical region are affected by the gravitational field and are sensitive to temperature gradients in the experimental cell. The HPT was developed to enable Prof. G. H. Findenegg, Technical University of Berlin (Germany), to study the critical adsorption of a pure fluid (sulphur hexafluoride SF₆) on an adsorbent with an atomically ordered surface (graphitized carbon). A new volumetric technique is implemented for the measurement of the surface excess amount at various temperatures along the critical isochore

starting at the reference temperature (60° C) and approaching the critical temperature (45.55° C).

Measurements of the surface excess amount performed on the ground with different versions of HPT are in qualitative disagreement with theory. This can be either due to the influence of gravity or to a genuine effect not accounted for by the current theory of critical adsorption.

Results from the first flight run are unexpectedly similar to those obtained on the ground, which would indicate that the discrepancy between the theory and the experiment is not to be attributed to gravity-driven effects. Five runs were performed and a careful and complete analysis of all flight data, as well as complementary runs on the ground after the mission are still necessary before one can draw a definite conclusion.

Surface Forces and Adhesion

Surface forces and interface energies of solids depend on a number of physical and physico-chemical parameters, such as the surface roughness and cleanliness, the temperature, and the mechanical properties of the contacting bodies, in particular their deformation properties. So far, measuring these on earth has always been hampered by the interference of much stronger forces, mainly the weight of the bodies. The SFA instrument was conceived to enable the study of the collision dynamics of 18 types of metallic projectiles, about 4 mm in diameter and 0.3 g in mass, and with velocities from 0.1 to 2 mm/s, on metallic targets made of gold, titanium, stainless steel, or nickel. The objective was to verify theoretical predictions such as:

- no rebound of the projectile below a threshold impact velocity;
- the dependency of the restitution coefficient on the impact velocity near the threshold which relates to surface energies and adhesion;
- the variation of the contact force with contact time which depends on the characteristics of surfaces forces.

Accurate and highly reproducible data could be recorded from a few thousand collision events during the mission, and surface and adhesion effects could be clearly identified.

The ERA facility, also onboard Eureka, is taking advantage of the flight characteristics (sun pointing) to achieve long-duration exposure of biological samples to the specific environment of space.

Exobiology and Radiation

When we enquire about the principles leading to the emergence of life from inanimate matter, its evolution, and its distribution on earth, we are still facing many unknowns. Exobiological research may add many new pieces of information to our concept of "life" by expanding research beyond the earth, to space and planets, the comets, and the meteorites of our solar

system. Such "cosmological" research calls for a multidisciplinary approach in which scientist in astrophysics, planetary research, organic chemistry, paleontology, and biology must work together.

The space environment has generally been viewed as extremely hostile to all forms of life, due to:

- the high vacuum, with pressure as low as 10^{-14} Pa;
- the solar electromagnetic radiation, extending from wavelengths; of 2×10^{-12} to 100 m
- the solar corpuscular radiation emitted in the solar wind and during the solar flares;
- the galactic cosmic radiation, consisting approximately of 86 percent protons, 12.7 percent He-ions, 1.3 percent heavy ions with charge Z greater than two, and electrons;
- the extreme temperatures determined by the deep space temperatures of 4 K and by the position of a body relative to the sun.

While this extreme environment represents a definite barrier for the active biological growth, metabolism, and reproduction, some living organisms such as the spores of bacteria and fungi have the capacity to survive harsh conditions in a dormant mode. However, the complex action of the factors found in the space environment cannot be fully reproduced in laboratories, and all theories so far have been based on results from laboratory experiments and a few short-duration space experiments. ERA was developed to give scientists the opportunity to fly experiments in space for a relatively long period of time. The facility accommodates two sample trays, one fixed and one deployable, containing sets of passive samples. It enabled scientists to expose biological samples to the solar radiation, the space vacuum as well as the deep environment. The samples will be analysed on the ground.

Space Science—Solar Physics—Technology

The flight conditions of Eureka were particularly suitable for a number of add-on instruments for investigations in astronomy, solar physics, cosmic particles, and technology.

The Wide Angle Telescope for Cosmic Hard X-rays (WATCH) of the Danish Space Research Institute (Prof. N. Lund) monitored about 20 sources on a day-to-day basis, and five bright new sources (transient) were discovered.

The Solar Spectrum Instrument (SOSP) operated for CNRS Paris (Dr. G. Thuiller) allowed to measure the absolute spectral irradiance of the Sun between 170 and 3,200 nm and to detect its variation with the solar cycle. The Solar Constant and Variability instrument (SOVA) of the Royal Meteorological Institute of Belgium (D. Crommelynck) allowed the determination of the Solar Constant, its variability, and its spectral distribution at five different wavelengths. The Belgisch Instituut voor Ruimte Aeronomie, Brussels, (Dr. E. Arijis) measured

aerosol and trace gas densities in the earth's atmosphere with the help of the Occultation Radiometer (ORA). The instrument measured the solar radiation during sunrise and sunset to determine concentrations of ozone, nitrogen dioxide, water vapour, carbon dioxide, background and volcanic aerosols, and dust from 20 km up to 100 km altitude.

The Timeband Capture Experiment (TICCE), proposed by Dr. J.A.M. Mc Donnell, University of Kent, Canterbury, aimed at studying the population and chemical composition of particles in near-earth space.

New technologies could be successfully tested under real conditions. The Radio Frequency Ion Thruster Assembly (RITA) developed at MBB [Messerschmitt-Boelkow-Blohm] Ottobrunn, Germany showed its ability to generate a variable thrust between 5 to 10 mN. An ESTEC team led by Mr. P. Sever tested an interorbit communication system installed on the spacecraft which was extremely helpful in receiving real-time data on the ground via Olympus, in complement to the EURECA data transmission. The Advanced Solar GaAs Array (ASGA) developed at CISE [Center of Information, Studies, and Experiments] Milano showed the excellent performances in terms of a very-high-power output and a stability to the environmental effects.

AUTOMOTIVE INDUSTRY

EC Funds Traffic Safety Project at Renault, PSA

MI1507151793 Eschborn NACHRICHTEN FUER AUSSENHANDEL in German 3 Jun 93 p 1

[Text] The EC Commission has approved a French state subsidy for joint research and development projects by the automobile producers Renault and PSA amounting to 207.75 million French francs [Fr]. The project will develop measures to improve vehicle and road traffic safety. According to a Commission statement, the program extends over five years, comprises 28 percent basic and 72 percent applied research, and will cost an estimated Fr650 million. At the same time, the EC Commission instituted proceedings yesterday under article 93 (2) of the EEC Treaty on account of a suspected subsidy from the Trust Agency to Leuna AG.

Bundespost To Install Zinc Batteries in Electric Vehicles

MI1607120893 Bonn DIE WELT in German 17 Jun 93 p 9

[Article by Norbert Lossau: "Three-Minute 'Electrogas' Refuel: Israeli Scientists Have Developed Novel Energy Storage Unit—German Post Office Plans Use in Electric Vehicles"]

[Text] An electric vehicle whose novel battery system is likely to revolutionize transport technology is currently being tested at the Bavarian TUV [Technical Monitoring Board] in Munich. From the technical point of view, the energy storage unit in the electric test vehicle,

registration number M-LJ 9199, is streets ahead of all previous electric car battery systems: It is lighter, cheaper, does not go flat when left to its own devices, and has a virtually unlimited life; nor does it need to be plugged in for hours to recharge, as it can "fill up" with "electrogas" in just a few minutes.

The success story began about five years ago in the Californian firm LUZ's Jerusalem laboratory, where emigre Russian physicist Dr. Ina Gatkin, who was researching into the energy properties of zinc, had found work. It has been known for decades that zinc can be used to make high energy-density batteries. Even the little standard 1.5-volt batteries have a zinc electrode that produces electric energy by an oxidation process. But this energy density is far from sufficient for an electric car battery.

To increase the efficiency of zinc batteries one "only" has to enlarge the zinc electrode's active surface to expand capacity and raise energy density. But the very fine zinc powder required is extremely flammable and is therefore virtually impossible to process. However, when most research laboratories had long since given up developing the zinc battery any further, Ina Gatkin made the breakthrough. She found a simple way of making "noninflammable zinc dust" that can safely be processed into porous electrodes with an extremely large inner surface. When immersed in a weak potash lye and supplied with oxygen, these sponge-like zinc electrodes become powerful suppliers of electric current, achieving an energy density of 300 watt hours per kilogram—about 10 times as much as a lead accumulator.

Ever since, battery and motor industry experts have been making the pilgrimage to Jerusalem to see the power of the new zinc battery for themselves. Electric Fuel Limited (EFL), as the 50-strong Jerusalem company styles itself since its Californian parent went bankrupt, is keeping the formula for making the miraculous zinc powder strictly secret. Licences cost millions.

Deutsche Bundespost is particularly interested in the new Israeli zinc batteries. Its Bonn consultancy Detecon is looking into whether they could be used in electric mail vans. Detecon project chief Guenter Boehm says the batteries available to date are unsuitable for use in the Bundespost's electric cars: Their capacities are too small, they take too long to charge, and they are too short-lived to be used economically in a large fleet of vehicles.

Then Walter Trux, former Board Chairman of Flachglas AG and now chairman of the Bundespost's supervisory board, happened to hear about the revolutionary battery system from Jerusalem and immediately gave this "very environment-friendly" technology his backing. The present series of tests at the Bavarian TUEV, in which a 3.5-tonne electric Mercedes was fitted with EFL zinc batteries, have been arranged and financed by the Bundespost.

TUEV engineer Gebhard Krebs, who is in charge of the trials in Munich, is fascinated by the new battery: Even when the entire vehicle has been standing for three days in a cold chamber at -20 degrees, the battery immediately supplies sufficient power; in traffic, acceleration and road behaviour are quite comparable with a similar diesel vehicle, he says.

Guenter Boehm reports that driving tests with the loaded Mercedes O 180E in stop-and-go traffic had given a range of 300 kilometers (equivalent to 500 kilometers in a Volkswagen Golf. With this battery capacity, Bundespost vehicles could run for at least a week. Then, instead of recharging the batteries at an electric socket, the used (oxidized) zinc electrodes are simply removed from the modular battery and replaced by fresh ones. This "electric refueling" takes three minutes. The Bundespost intends publicizing the successful Munich battery trials officially at the end of August.

The zinc battery causes no environmental problems. The used electrodes can be regenerated without difficulty in a special process using electrical power from a power station or a solar cell. This can be done anywhere where power is (cheaply) generated. For example, the zinc batteries in the Munich test vehicle are "refueled" with solar power from the desert outside Jerusalem and flown back to Bavaria "charged."

Test results to date are so promising that the Bundespost will probably decide to replace part of its diesel fleet by electric vehicles with EFL batteries. However, they must first find a motor manufacturer who is prepared to make suitable vehicles to Bundespost specifications, disregarding the expensively developed electric storage systems.

Walter Trux is concerned that German industry might miss an important innovation opportunity here. He hints that foreign car firms have already expressed their interest in building EFL vehicles. But everyone will have an opportunity to tender for the project.

The new battery system is obviously ideal for use in fleets where all the vehicles return to a common depot where the electrodes can be replaced. Boehm envisages the Bundespost having such stations equipped with block-type thermal power stations that are efficient producers of heat and electric power.

But Trux's vision extends further. He is convinced that the new batteries will be the start of electric cars replacing today's gasoline and diesel vehicles worldwide. The motor industry is under threat of its internal combustion engine and battery systems being written off. Zinc batteries would be "charged" in a closed circuit, possibly carried by ship to countries where hydroelectric or solar power is plentiful, or regenerated at local power stations in periods of low demand. He hopes it may perhaps one day even be possible to replace the sponge-like electrodes with an energy-rich "zinc fluid." Then cars could simply fill up with fuel in the form of "liquid electricity" at a filling station.

Volkswagen's Plans To Build Supereconomical Auto
93WS0517B Frankfurt/Main FRANKFURTER
ALLGEMEINE in German 8 Jun 93 p T1

[Article by Almuth Burgdorf: "Toward Three-Liter Auto; Economy Strategies at Volkswagen: Economical Golf Due This Fall"]

[Text] The Volkswagen Corporation, including the brand names VW, Audi, Seat, and Skoda, has set itself an ambitious objective with regard to fuel economy. It wants to develop vehicles that need only 3 liters of gas per 100 km. To achieve this, autos have to become increasingly lighter and more streamlined, and engine technology more ingenious. Cars with that little thirst are, of course, no longer utopia. In the past technological innovations in particular had already led to a fuel of economy of 25 percent. At the present time proposals are already being discussed within the European Community that air for a fleet consumption level of 5 liters per 100 km by 2005.

In the first place, lighter vehicles have to be built without making concessions to safety. Aluminum is a good material for this. If the medium-class Audi, for example, were to be provided with an unfinished body made completely of aluminum, up to 45 percent of its weight could be eliminated. The replacement of conventional materials in individual components also results in a lighter auto. Thus as much as 50 percent of the weight can be eliminated by using fiber glass-reinforced plastic instead of sheet steel. Coal fiber-reinforced plastic weighs only a fourth of what the conventional material weighs. Additional economies are possible by using "tailored blanks." With this technique sheets of material of different strengths are used for individual components. This results in weight advantages over conventional parts, which are made from metal of the same strength.

The auto body's resistance to air must also be further reduced. Unfortunately, the faster one drives, the greater the resistance. To double the speed, an engine puts out not twice, but eight times as much power, primarily to overcome the greater resistance to air. Obvious improvements are still possible and necessary, especially as concerns the design of the underbody.

Occupying a decisive position, engine technology can make a greater contribution to reducing consumption. As VW engineers also know, diesel engines with direct injection are especially energy-saving. With these engines the fuel is injected under high pressure not into a precombustion chamber, but directly into the combustion chamber, where the diesel oil is ignited by the high compression. This system is extremely exacting electronically and it requires an oxidation catalyzer that cuts in afterward, which reduces carbon monoxide and hydrocarbon emissions. The combination of a catalyzer diesel and the computer-controlled momentum-utilizing automatic system (SNA) developed by VW can lower real consumption by an additional 20 percent over that of the already

economical catalyzer diesel. Depending on the component, pollutant emissions will also be reduced by from 10 to 35 percent. This economy technology of VW's is based on a simple principle: An economical engine that produces a minimized amount of exhaust emissions must only run when its power output is really needed. When that is not the case, the momentum-utilizing automatic system disengages the engine from the drive train; it falls silent and the vehicle rolls without any engine-braking action. To start it up again, one only has to step on the gas pedal; the automatic start-stop system takes care of the rest. The economy Golf, which is electronically extremely costly, is to go into mass production in the fall.

BIOTECHNOLOGY

France's Bio Avenir Program Judged Successful
93WS0527D Paris AFP SCIENCES in French
27 May 93 p 31

[Unattributed article: "First 'Very Positive' Assessment of the Bio Avenir Research Program"]

[Text] Paris—Eighteen months after the start of the Bio Avenir program, associating Rhone-Poulenc and several large French research organizations, "the first results prove very positive, even exceeding set objectives," especially with respect to aging disease control, the group's chief executive officer, Mr. Jean-Rene Fourtou, indicated on 26 May.

"Our future depends on our innovations, hence the importance of succeeding in this original approach which closely associates basic and industrial research scientists," Mr. Fourtou went on at a press conference.

Launched in November, 1991, Bio Avenir associates the leading French pharmaceutical and chemical manufacturer and several large basic research organizations—CEA [Atomic Energy Commission], CNRS [National Center for Scientific Research], INRA [National Institute for Agronomic Research], INSERM [National Health and Medical Research Institute], Pasteur Institute—as well as universities, with the support of the Ministries of Research and Industry.

The objective of the program is to accelerate the process of discovery of new scientific facts in the life sciences and in biochemistry, and to transfer them to the industry.

"Bio Avenir represents the most achieved form of association between public and industrial research," the minister of research and higher education, Mr. Francois Fillon, pointed out for his part. "It is an example of a fruitful large program and a model of joint programming between public research and a major industrial corporation." The minister also emphasized Rhone-Poulenc's efforts in the field of life sciences and said he was "ready to consider a similar program" in the field of chemistry.

Over five years, Bio Avenir will mobilize over 500 researchers, with a budget of 1.61 billion French francs [Fr], including Fr1 billion financed by Rhone-Poulenc. By the end of 1992, over Fr300 million had already been committed, 350 researchers were working at the program, and four joint laboratories (with the CNRS, the INRA, and the CEA) had been created or expanded.

Within a year and a half, the research performed resulted in 50 scientific papers and the filing of 25 patent applications. In the field of human health, the researchers identified the respective roles of the various factors involved in reverse cholesterol transfer.

Progress in the understanding of degeneration and neuron-death phenomena, and the use of a vector to transfer genes to the brain should also contribute to the prevention and treatment of aging diseases (Alzheimer's, Parkinson's).

Significant results were also obtained in agriculture (fungus control, herbicide-resistant crops), in biochemistry, and in methodology.

COMPUTERS

Netherlands: Parallel Computer R&D, Applications Evaluated

BR1607130093 Zoetermeer WETENSCHAPSBELEID
in Dutch Jun 93 pp 6-9

[Article by Wim Heiko Houtsma: "Massively Parallel Computers: Still No Standard System"]

[Excerpts] "There is always a demand for larger, more powerful, faster computers. They are the only way to keep human curiosity satisfied." This has led to the advent of what is known as High Performance Computing and Networking [HPCN], which opens up new possibilities for industrial and academic research. According to those involved in it, HPCN represents technology which will strengthen the position of European industry and science on the one hand while guaranteeing economic growth, the quality of life, and an approach to environmental problems, on the other: a genuine supercomputer, indeed. [passage omitted]

Japan and the United States

At the end of last year, the new generation of supercomputers hit the headlines when the HPCN advisory committee, at the request of the European Commission, took stock of developments in the field of supercomputers. The Rubbia committee—named after its chairman—not only singled out the above link between economic growth, a better environment, and personal welfare on the one hand and the introduction of massively parallel processors (MPP) on the other, but it also pointed to the fact that Europe is lagging behind the United States and Japan. In these countries, MPP technology is receiving high government subsidies because it is regarded as a key

future technology. The Rubbia committee reported that if Europe wanted to stay in touch, funds would have to be provided.

European attention to massive parallelism has also been translated into developments within the Netherlands. For example, the Ministry of Education and Science has set up an HPCN initiative group, which presented its future plans in mid-May at the HPCN '93 conference. During the same conference, the University of Amsterdam and the Center for Mathematics and Information Technology opened the "Interdisciplinary Center for Computer-Based Complex Systems Research Amsterdam," which will form a platform for HPCN activities. This center (abbreviated to IC3A) will enable industrial and research establishments—both within the Netherlands and abroad—to pool their expertise and to share sophisticated computer systems.

A similar initiative has also been launched by the NWO's [Netherlands Organization for Scientific Research] Foundation for Netherlands Computer Facilities (NCF), which wants to set up an MPP service. It currently has an application pending for a minimum of 6.5 million guilders with the Intentional Equipment Scheme run by the Ministry of Education and Science, which is partly intended to encourage the acquisition of several massively parallel computers.

Standard

The introduction of massive parallelism can therefore count on considerable support from the government and major research establishments—in both the academic and business world—as has already become evident. Ongoing projects are making progress in areas of research where solutions seemed virtually impossible until very recently. A.T. Langeveld, head of the Computational Applications Department at Shell Research, is very satisfied with MPP at the Shell laboratory: "We have been working with massively parallel computers now for around three or four years and it has really been worth the investment." The major research institutions in particular are also enthusiastic about the development of MPP. They have their own computational research departments.

However, Shell Research and academic computer scientists may be in a position to make significant advances, but this is not the case for smaller groups. Indeed, all those involved in MPP admit that the smooth implementation of a new program on this new generation of supercomputers requires a substantive amount of preliminary experimentation. In their contribution to the paper supporting the NCF application for funding, A.P.J. Jansen and R.A. van Santen of the Technical University of Eindhoven have stated that fields where only existing software is used will, for the time being, have little use for MPP systems. "In these fields, standard software for MPP systems must first be available. Even fields involving programming on a regular basis will not suddenly start using MPP systems. (...) Given

how difficult it is now to write a good program for an MPP system, the amount of time saved has to be considerable, but it is by no means certain, based on current understanding, that this saving will actually be possible."

J. P. Hollenberg, head of the sciences services department of the Amsterdam Computing Center Foundation (SARA), also points to similar problems in the business community. "Industry would rather buy an overall product—hardware, control software, and applications in one." E.A.M. Odijk of Philips, who was closely involved in parallel computing before his employer withdrew from the computer business, adds that "it is not enough just to offer your customers a good computer. Industrial computer centers only buy tried and tested technology, which means that they have to be able to see applications running."

L.O. Hertzberger [of the Computer Department of Amsterdam University] stresses that this "expectant market" syndrome goes hand in hand with the fact that MPP is still very young. "With MPP, we are now at about the same level as they were with vector computers 10 years ago. We still need good compilers, a lot of work still has to go into training, and suitable applications still have to be developed."

According to Hertzberger, these uncertainties mean that it is not yet clear which of the various massively parallel systems will eventually be accepted as standard. As long as this standard architecture is lacking, the market will remain reticent—it does not want to invest time and money in MPP architectures which will have to be replaced by different architectures at a later date. [passage omitted]

[Box, p 8]

The European Market

The European computer sector has strong points which are different than those of its American and Japanese competitors. According to the Rubbia committee, know-how in the field of simulation research and modeling techniques is prominent in Europe, as is knowledge of the development of parallel software technology. However, hardware production is severely underrepresented in the European computer industry.

The answer to the question of whether Europe should also follow the path of massive parallelism is a resounding "No," at least from committee-member Professor L.O. Hertzberger. "I do not think Europe should try to produce hardware. In the field of network stations, Europe has lost the IBM, Hewlett Packard, and SUN markets and, in supercomputers, Europe has had to give in to Cray, NEC, and Hitachi. However, the market for embedded systems is much greater, where parallel computers are built into a consumer article. This very market is now dominated by Europe."

These embedded systems are also the only branch of MPP which has already been fairly successful on the market. They can be built into a hands-free telephone,

for example, where a small parallel computer is used to filter out disturbing background noise in real time. This requires a high processing speed, which can be provided relatively cheaply by MPP.

DEFENSE R&D

France: Sextant Avionique Military Positioning System Tested

BR2307092193 Paris *LA LETTRE DU GIFAS*
in English 17 Jun 93 p 2

[Unattributed article: "Sextant Avionique: Topstar GPS Military Receiver"]

[Text] Sextant Avionique's GPS [global positioning system] Topstar P/Y receiver was mounted to a Mirage 3 of the Bretigny Flight Center and made a successful first flight on PPS (Precise Positioning Service) mode. (Sextant Avionique contact: Mrs. Fayolle; phone: 33/4629 8831.)

The test validates the complete decoding function of GPS signals. This highly protected function enables authorized military operators (including France and the NATO countries) to avail themselves of all the precision of the GPS system (10 meters and 0.1 m/sec on three axes) while obtaining maximum resistance to jamming devices, decoys, and chaff.

The Topstar receiver is miniaturized in the form of a sensor box. It is easy to install and is carried by the French Air Force's Rafale and Mirage 2000-D fighters and designed for updating of other Air Force carriers. The receiver is wired-in to the system with no substantial modification in existing equipment being necessary to make all GPS performance available.

This development has necessitated the acquisition of important new facilities by Sextant Avionique. A specialized laboratory, a highly qualified team, and special simulation facilities have been set up and approved by the specialized services of the General Arms Directorate [DGA]. This is the first French PPS P/Y receiver.

ENERGY, ENVIRONMENT

France: CEA Develops Phosphine Detector

93WS0513B Paris *L'USINE NOUVELLE*
TECHNOLOGIES in French 20 May 93 p 16

[Article by Anne Lombard: "The CEA Tracks Toxic Gases"; first paragraph is *L'USINE NOUVELLE* *TECHNOLOGIES* introduction]

[Text] Simple and highly selective, the technology the CEA (Atomic Energy Commission) has devised to detect phosphine will also be able to measure NO₂, and even other toxic gases.

The CEA's recent development of a non-polymer, organic sensor prototype to detect phosphine (PH₃) has set it on the

path to devising a simple and extremely selective technology for measuring toxic gases. The Commission is developing a second application to measure NO_2 .

The device is based on the use of Langmuir-Blodgett films, which are single-molecule organic films that can be transferred to a solid substrate (any material, provided that it features a plane surface and marked hydrophilic or hydrophobic characteristics).

"The molecule we chose, which is selectively sensitive to phosphine, conducts electricity," explains Andre Barraud, director of the CEA's Organized Molecular Systems Lab in Saclay. "Since its electrical conductivity drops in the presence of PH_3 , technicians can measure variations in resistance. Detectors are ordinarily bothered by ammonia, which is the phosphine interferant most commonly used in chemical laboratories. Our sensor is an exception: Indeed, its selectivity is $4,000/\text{NH}_3$."

In other words, for 1 ppm of phosphine (primarily used by the electronics industry to manufacture doping phosphorus), the variation in resistance is the same as for 4,000 ppm of NH_3 .

The CEA's sensor contains a double cell—one for measuring and one for use as a yardstick—and makes differential measurements. It detects phosphine at levels close to 0.3 ppm. That is the acceptable limit. Indeed, "Once you begin to smell phosphine, you are already dead," quips Andre Barraud, dramatically summing up the situation.

The detector's only drawback is that it is partially reversible (technicians must zero it between two measurements) and ceases to function beginning at 45°C . As it happens, standards require temperature resistance of 70°C .

France, Finland To Build Clean Power Plants

93WS0527C Paris AFP SCIENCES in French
27 May 93 p 23

[Unattributed article: "CNIM [Shipbuilding and Industrial Construction Company of the Mediterranean]-Ahlstrom Partnership for 'Clean' Boilers"]

[Text] Paris—The CNIM (France) and Ahlstrom (Finland) groups will become partners to market Finnish "clean" circulating fluidized bed (LFC) boilers; in a second stage, they plan to develop a new generation of this very promising type of power plants.

As a result of this agreement, they will set up a joint marketing team based in Paris, which will take the form of an economic interest group (GIE), we learned from both companies. The two are well acquainted with each other: CNIM (formerly Industrial Constructions of the Mediterranean) has been a licensee of the Finnish group since 1986. More recently, the French company acquired a 9.6-percent interest in a Polish boiler manufacturer taken over by Ahlstrom.

The partnership announced "is far more than a mere licensing agreement, since it represents an extended

collaboration that covers sales and the construction of large steam generators to produce electricity," the joint communiqué pointed out.

The two partners pin all their hopes on the LFC technology, which is to be used, among other sites, at Gardanne (Bouches-du-Rhône): this type of power plant can use lean fuels, and the fumes discharged into the atmosphere are less polluting than those of traditional power plants.

France: Experimental Household Waste Treatment

93WS0527E Paris AFP SCIENCES in French
27 May 93 p 33

[Unattributed article: "Success of an Original Organic-Waste Sorting Out Experiment in Bapaume"]

[Text] Bapaume—The "green garbage can" experiment organized in Bapaume (Pas-de-Calais) and involving the sorting out of organic waste, was a success and will be extended to 27 rural communities representing 22,000 inhabitants.

For one year now, the people of Bapaume have conscientiously sorted out their organic waste (vegetable peelings, food leftovers, lawn cuttings, disposable diapers, etc.) and their newspapers and put them in the same container. This experiment, a first, makes it possible to produce high-quality compost and to use 40 percent of all household waste, which until now was sent to the garbage dump. According to the mayor of Bapaume, Mr. Jean-Paul Delevoye, the operation—in which Rhone-Poulenc and Procter & Gamble (Pampers) participated—is so conclusive that he will extend it to all 27 communities of the SIVOM (Multiple-Purpose Intercommunity Syndicate).

The people's active participation in the experiment, in spite of the constraints it involved, was the key factor in the success of the pilot stage. Once a week, the "porters" (sanitation engineers), who were given suitable training, pick up the special cans containing all fermentable household waste, and do not hesitate to point out errors (no magazines, yogurt cups, or detergent pails). Ninety-two of the people involved said they were satisfied with this collection, even though the waste pick-up fee was doubled, from 100 to 200 French francs [Fr].

In Bapaume as in many communities, traditional garbage dumps are nearly full. A solution had to be found, especially as the new law provides that household-garbage dumps will eventually be banned. Of the 20 million tons of household waste that the French generate each year, 45 percent are incinerated, 46 percent still go to the garbage dump, and only 9 percent are processed into a compost that is often of mediocre quality.

On the contrary, the compost produced from the Bapaume "green garbage cans" is of exceptional quality because the organic waste is sorted out at the source. It does not contain broken glass, or pieces of plastic, or worrying quantities of heavy metals, and the cellulose from the paper and diapers provides carbonated regulating elements ensuring a good soil structure.

Next year, the SIVOM will build an expandable unit with an initial treatment capacity of 3,000 tons of organic waste. Treatment starts with several fermenting stages, followed by sifting and, finally, refining. The latter stage might use earthworms (lombriculture). Worms digest the waste, leaving only the last pieces of plastic (diapers again) or broken glass that the "porters" might have overlooked, and which are easily disposed of. At the end of the process, the original waste has become "a somewhat nobler product"; it has turned into a fine compost with a woody fragrance, the high performance characteristics of which were tested and verified by Rhone-Poulenc laboratories.

These qualities which experts say "equal those of manure," might enable it to compete with plant and garden composts, which are essentially peat-based and about 200,000 tons of which are sold in France every year.

France: Atochem's Five-Year Pollutant Reduction Plan

93WS0589A Paris INDUSTRIES ET TECHNIQUES
in French 7 May 93 p 71

[Article by Pascal Lyon: "Atochem Kicks Off a Figure-Specific Pollutant Reduction Plan"; first paragraph is INDUSTRIES ET TECHNIQUES lead]

[Text] The chemical manufacturer has announced product-by-product five-year objectives—an action almost unparalleled in Europe.

There can be a tremendous gap between election promises and post-election actions. Manufacturers are not so lucky. They can scarcely afford to make promises that will only be binding on those who believe them. So it takes courage to announce an environmental plan that promises a 50-percent reduction in tonnage discharges of 17 specific substances in five years. Failure to meet such a goal would damage the credibility of both the person who promised it and his company. Yet that is exactly what Jacques Puechal, chairman and chief executive office of ELF [Gasoline and Lubricants Company of France] Atochem, did do during his conference announcing the company's results.

These 17 substances currently represent over 16,000 metric tons (1992 figure). But Jacques Puechal is not limiting his commitments just to these substances that require a special effort. Atochem's chairman and CEO has targeted other areas, too. In the area of air emissions, he intends to reduce nitric oxide emissions by 25 percent. Water discharges should be cut by 30 percent (according to the Union of Chemical Industries environmental index). With respect to in-house processing of hazardous wastes, the company, which already processes

90 percent of the 380,000 metric tons it generates, will increase that percentage to 95. The target date for all this is 1997.

The only declines that hearten Jacques Puechal this year concern pollution. He stresses the fact that, of the 10,000 European chemical manufacturers belonging to CEFIC (European Council of Chemical Industry Federations), only 25 will publish a report on the environment, 15 of which will specify goals. He goes on to say that manufacturers in France are required to report their discharges, which is not the case in other countries.

For Atochem, the cost of the pollutant reduction measures represents 3.5 percent of annual sales (45.7 billion French francs [Fr] in 1992 compared to Fr50 billion in 1991) and 900 managers and supervisors, half on a full-time basis. The report deals only with Europe, that is, the 59 major industrial sites of ELF Atochem, Grande Paroisse (fertilizers), Appryl (polymers), and AtoHaas (technical plastics). U.S. and Asian operations are not included. Jacques Puechal appeared disinclined to combine everything in a single report given the contextual differences among the three zones. The U.S. companies engaging in this exercise also differentiate among the three zones.

While announcing figures is risky, it is very useful for measuring progress. It is the only way to prove that real changes are occurring and that long-term action is essential. It is also a way of showing that all industrial sites are not evolving in the same manner. For example, the water index for the group as a whole went from 1 to 0.34 between 1984 and 1992. However, if one looks at the Carling and Lannemezan sites, which went from 1 to less than 0.1 in the same period, the rate of change is very different: almost regular for the first site and very fast from 1984 to 1987 and slower thereafter for the second. A site's pollutant load can also change enormously in a matter of weeks when one manufacturing technology is discontinued in favor of another, clean one. Sodium chlorate production at Jarrie no longer generates chromium wastes. At Carling, going over to mass polymerization of styrene has made it possible to recycle the unused monomer. The chlorine-soda unit at Fos-sur-Mer now uses a less polluting membrane process.

These water-related actions have their counterparts in energy saving and air emission measures. So that each site knows how it is doing and where it is going, internal audits are conducted periodically and followed up by action plans. Now what we need to see is this kind of publication from the other chemical groups.

[Box]

ELF Atochem's five-year objective is to reduce its water discharges by 30 percent. Nitric oxide air emissions will be reduced by 25 percent. For 17 closely monitored substances, discharges will be reduced by 50 percent.

Air Emissions	
	(Tons per Year)
Dust	3,784
SO ₂	21,500
NO _x	11,975
CO	11,466
Organic Compounds	19,869
Inorganic Compounds	4,431
Metals	1
TOTAL	73,026

Water Discharges	
	(Tons per Year)
DCO	13,196
NTK Nitrogen (Total Kjeldahl nitrogen)	3,628
Phosphorous	1,027
Toxicity (daphnid test)	278
Metals (Hg + Cd + Pb + Cr + As)	4
Metals (Zn + Cu + Ni)	8
ELF-Atochem-specific substances	261
TOTAL	18,402

The 17 Closely Monitored Substances	
(Almost 16,000 Metric Tons in 1992)	
Ammonia	
Benzene	
Chloroethane	
Chlorofluorocarbons	
Vinyl Chloride	
Vinylidene Chloride	
Dichloroethane	
Ethylbenzene	
Methyl Methacrylate	
Styrene	
Tetrachloroethylene	
Tetrachloromethane	
Toluene	
Trichloroethane	
Trichloroethylene	
Trichloromethane	
Xylenes	

Italy: Environmental Research Program Assessed

M12307092693 Rome AMBIENTE in Italian May 93 pp 36-41

[Article by Giuseppe Bianchi, member of the committee nominated by the scientific research minister to evaluate the proposals presented under the auspices of the national environmental research program: "The Keys to the Future"]

[Text] CIPE [Interministerial Committee for Economic Planning] approved the first national environmental research program in 1990. It had been prepared for the Ministry of Universities and Scientific and Technological Research by a committee of experts under the chairmanship of Science Minister Ruberti.

Successively, the same minister issued a decree inviting offers from subjects wishing to nominate themselves to initiate research into the various topics described in the plan.

[Science] Minister Fontana has recently set up a work group to collaborate with the ministry. This group will study the offers received and prepare an analysis of the scientific, technological, and economic validity of the research proposals. The group will also be involved in the later stages of actuation of the program.

A considerable amount of time has passed between the conception of the environmental research program, its commencement, and the choice of those who will work on it. Therefore, it does not seem untimely to reflect on the way in which the program itself fits into the current phase of national environmental policy, and to also consider whether or not the program meets the needs that have matured during this interval.

The Long-Term National Plan for the Environment

An environmental research plan should be developed and implemented within the framework of a global plan that embraces all national initiatives and programs concerning the protection and safeguarding of the environment.

Research is, in fact, just one of the array of instruments that are available to the government for its programs in the sector.

Other methods of public intervention are legislation, public investment, taxation, and finally the divulgation of information that will influence citizens and companies to respect the environment of their own free will.

The question we need to ask ourselves is therefore: Does this global plan exist? The reply is affirmative: although it is still in a version that is incomplete, the environment minister recently published a 10-year plan for the environment (DECAMB) that has been drawn up by the ISPE [Institute for the Study of Economic Programming]. It is an extremely voluminous document, both as regards the program and indications of how the proposals should be put into effect. This document suggests a series of reflections:

1. The plan must give an overall view of the situation and coincide with all the environmental measures affecting widely differing fields and sectors. It must cover a long period of time in order to give preventive measures precedence over the emergency measures that have been typical of government programs in the past.

2. The preparation and enforcement of more severe legislation, that will influence the behavior both of individuals and of companies, is the main instrument for a correct environmental policy.

The first thing to be done in this respect is to bring our legislation into line with the directives and norms of the European Community.

It is equally important to encourage and implement the absorption of environmental costs sustained by companies and the community, into prices and tariffs. This not only makes resources for the necessary environmental programs available, but also makes citizens better understand the economic value of the environmental "resource."

3. The current situation is not favorable for the environment: economic policy is characterized by its indifference and inconsistency with regard to the environment, and there is no structure linking economics, ecology, society, institutions, and the environment.

A single coordinated policy is therefore necessary at the highest level of the environment ministry, to overcome the "backyard" logic that has caused the efforts made up to the present day to be substantially fruitless, or at least has reduced their effectiveness to defend the environment. One possible solution is the setting up of an "interministerial committee for the environment" chaired by the head of the government.

This is not a new type of solution and perhaps not a very effective one. Nevertheless it seems to us that it would be a useful step forward, with respect to the confused situation we have at the present time. A more courageous solution would be to entrust a deputy prime minister with the coordination and planning of matters regarding the environment, leaving the present environmental minister to implement those programs that have specifically been delegated to him.

4. Priority should be given to the establishment of an extensive program of public funding to safeguard the environment, and assistance to companies should be limited to support for research.

In view of this priority, public funding could only be considered for resolving emergency situations in which the public interest is prevalent. These situations may not just be connected with safeguarding the environment, but may also include safeguarding the economy, by trying to avoid the simple remedy of closing the factories that cause environmental emergencies.

Especially in our country, priority should be given to the preparation of a single reference plan for the future use of land that is still available, and for eventual changes in

the destination of land already being exploited. Particular reference should be made to the localization and delocalization of potentially polluting industries.

5. As for the management of the plan, "objective indicators" that can be pursued and measured, should be defined. General statements, which are usually rhetorical or demagogical, should be left aside and the fixed objectives of the programs should be controlled and followed up. These indicators should show both quality and results at the same time.

6. With respect to an environmental policy that is essentially directed toward the control and containment of local pollution, the subject of sustainable development remains important and has a wider range of implication, with respect to both territory and time.

The depletion of the ozone layer, the greenhouse effect, the depletion of natural resources, implications for future generations, the necessity to anticipate events, the protection of nature and biodiversity, are matters that are affecting the entire globe. The countries that are in a stage of economic transition and the developing countries must also collaborate. Therefore protocols and international conventions that stimulate, promote, and regulate North-South, East-West cooperation are essential.

7. Finally, as far as the general objectives of the plan are concerned, they can be summarized as being the three fundamental requirements given below:

- the stabilization or reduction of emissions of carbon dioxide, of other gases that are causing the greenhouse effect, and all the other emissions that are polluting the atmosphere;
- the protection of the land, the seas, and the various water cycles;
- the rational use of natural resources, particularly by recycling raw materials.

The sum total of the programs, with their numerous measures aimed toward these objectives, could be the first step toward the achievement of the aims of the programs themselves. The environmental programs have the specific scope of defining the new norms and general rules to be followed for the management of emissions into the atmosphere, water cycles and refuse, as well as noise and risks.

The environmental compatibility programs are drawn up to constrain the development mechanism to adapt itself to the necessity of protecting the environment and to adequately promote the technologies that serve environmental needs, and for the adoption of "closed" production cycles, that is cycles that make provision for the utilization of by-products. These programs will lead to the redevelopment, reconversion, relocation, and possible closure of single production units or even entire categories or types of production units.

Finally, the instrumental programs must be prepared to make the development of the two preceding types of program possible. Research obviously has an important role to play here.

The internal links connecting the three above-mentioned types of program (see Table 1) distinguish the specific context in which the each scheme must develop, the special objectives that must be attained, and the subjects involved.

Table 1 - DECAMB: Programs, Objectives, and Subjects Involved

ENVIRONMENTAL PROGRAMS	
Urban environment	town centers and alternative centers; suburbs and metropolitan areas; new systems for cities and nonurban areas
Environmental conservation	protected areas and instruments for their management; interrelationship between protected areas and nonprotected areas
The atmosphere	the ozone layer; the greenhouse effect; acid rain; fruition of the air
Water	control of the quality of drinking water; sources of water pollution; registration of water reserves; areas where the water supply is at risk; water saving
Land	defending the land against damage resulting from agriculture; mining; quarrying; and natural events
Refuse	reduction of the quantity and danger level; management of refuse disposal and recycling
Forests	conservation of our forest heritage; enlargement of forest areas
Coasts	protection of the marine and salt-water ecosystems; control of coastal erosion also following coastal quarrying
Risks	management of activities at risk; emergencies and public information; redevelopment and relocation of industrial activities
ENVIRONMENTAL COMPATIBILITY PROGRAMS	
Agriculture	rational use of fertilizers and chemicals; liquid waste from animal farms; organic farming
Chemical industries	chemical industries that are clean and compatible with the environment; large centers and small production units; saving of raw materials and recycling of used products
Transport	air pollution, vehicles and fuels; acoustic pollution; containment of the growth in demand for transport; development of the public transport infrastructure
Energy production	increased efficiency of energy consumption; containment of fossil fuel consumption
INSTRUMENTAL PROGRAMS	
Institutions	institutional reform of international relations, both at central government and local government levels (regions, provinces and town councils)
Administration	agreements on programs between ministries, local authorities and public bodies
Information and control	development of the national information system (SINA), as a system of computer communications between all the information and decision-making centers that are involved in the programs connected with the environment
Technology and science	programming the major research lines and the amount of public funding to be made available
Economic policy	fiscal and financial measures (investments and incentives) able to influence the behavior of private companies and consumers
Education and information	specially-designed programs should start in the lowest school grades
Instructions	official manuals defining the necessary procedures and the preparation of the programs and projects from their conception
INVOLVEMENT IN THE PROGRAMS	
Families	negotiations and agreements with representative bodies such as associations representing consumers, schools and churches, cultural associations and those for the protection of the environment, aimed at attaining environment-friendly behavior from the public
Companies	programmed contracts at a national level to regulate private industry (taxation, incentives, technical assistance)
Public administration	technical preparation of government officials

Table 2 - First National Environmental Research Program: Subjects and Areas of Research

1. THE REDUCTION OF TRAFFIC EMISSIONS	
1. Reduction of polluting exhaust emissions	(a) innovative injection systems; new combustion chambers; multifuel fuel supply systems;
	(b) advanced induction and exhaust components for engines to reduce noise;
	(c) development of processes for the production of optimized fuel to reduce air pollution.
2. Methodology and checking systems for vehicle roadworthiness and maintenance	(a) measurement of the chemical-physical parameters that assure good engine performance;
	(b) portable electronic control equipment able to indicate the ordinary and extraordinary maintenance interventions that need to be effected;
	(c) on-board control systems able to indicate exhaust emission anomalies.
2. THE REDUCTION OF EMISSIONS PRODUCED DURING ENERGY PRODUCTION	
3. Improvement of fuel characteristics	(a) development of technologies for the production of fuel oil with a low sulphur content;
	(b) identification of new additives for the optimization of the water-carbon mixtures.
4. Optimization of plant cycles	(a) small and medium-sized plants that enable nitrous oxide and dust emissions to be reduced;
	(b) innovative combustion chambers for highly efficient gas turbines giving a low level of pollution;
	(c) technologies for the gasification of coal integrated with a combined gas vapor cycle.
5. Purification of fumes to reduce emissions	(a) development of innovative processes for the simultaneous removal of nitric and sulfur oxides;
	(b) filter systems for high temperature sulfur oxide fumes.
3. THE REDUCTION OF THE IMPACT OF AGRICULTURE ON THE ENVIRONMENT	
6. Methods and technologies to reduce the environmental impact of the chemicals used in agriculture	(a) evaluation of the environmental impact of chemicals used in agriculture and the study of low-toxic alternative or integrative chemicals;
	(b) rationalization and optimization of technologies and methods, and reduction of the use of chemicals;
	(c) preparation of diagnostic kits to measure the residual quantities of active ingredients present in agricultural products.
7. Methods and technologies to reduce the impact of the use of nitrogen and phosphorus on the environment	(a) evaluation of the use of alternative and/or integrative plant nutrients of natural origin;
	(b) rationalization of the methods of use and of the existing technologies in relation to the quality of soils and their position in relation to the water table;
	(c) development of a prototype of new equipment for the distribution of fertilizers.
8. The treatment and disposal of solid and liquid waste from intensive animal breeding farms	(a) the development of innovative technologies, possibly biological, for the treatment of odors and solid and liquid waste from pig rearing establishments;
	(b) the preparation of a control system for the continual monitoring of data relating to the safety of waste disposal;
	(c) the development of a complete system and toxicological and ecotoxicological tests.
4. THE REDUCTION OF THE IMPACT OF OLDER INDUSTRIES ON THE ENVIRONMENT	
9. Treatment of plastic materials to be reused as raw materials in production processes	(a) pilot plant for the transformation of complex polymers or compounds based on thermoplastic polymers;
	(b) pilot plant for the recovery of monomers and/or oligomers from polymers.
10. Treatment of industrial waste to render it nonpolluting and to remove and recycle the metals it contains	(a) development of innovative processes for the treatment of effluents containing heavy metals, aimed at obtaining metallic compounds in a pure state that can be reutilized by industry;
	(b) treatment and transformation using oil containing PCB [polycarbonates] to render industrial waste nonpolluting.

Table 2 - First National Environmental Research Program: Subjects and Areas of Research (Continued)**4. THE REDUCTION OF THE IMPACT OF OLDER INDUSTRIES ON THE ENVIRONMENT (Continued)**

11. Reduction of emissions from steelworks through innovative technologies for the treatment and recovery of effluents	(a) pilot plant for the removal of the nitrogen compounds present in the effluent from coke-ovens and pickling plants;
	(b) pilot plant for the treatment and disposal of the sludge from the first stage of iron production and/or oily sludge;
	(c) definition of new conditions for the sintering process cycle.
12. Development of processes and systems for the reduction of pollution from the production of raw aluminum	(a) process technologies for the reduction of the emissions of fluoride compounds and their recycling in the electrolytic process;
	(b) replacing the current coking cycle of pitch, with a cycle able to utilize the distillates as a fuel for the anode ovens;
	(c) treatment of cathodic residues and expended salt slag to reduce toxic waste and extract utilizable substances.

5. HIGHLY RELIABLE AND SAFE PROCESSING FOR THE THERMAL DESTRUCTION OF REFUSE

	(a) pilot plant to test the extremely high temperature plasma-arc system that is able to transform both solid and liquid waste into its basic components; study of possible resultant toxic effects or damage to the ecosystem that could affect the environment;
	(b) disposal of toxic and poisonous waste in the blast furnaces used in the cycle;
	(c) innovative technologies for the burning of refuse that has possibly been pretreated, perhaps through a gasification cycle; evaluation of the economic viability of this system.
14. Mobile system for the treatment of dangerous waste	(a) innovative planning of a mobile system for the disposal of dangerous waste;
	(b) development of a system of this type and testing of its validity on samples of many different types of waste.
15. Technologies for the reclamation of polluted land	(a) vetrification of polluted land by heating using the Joule effect; capture of effluent gases; testing on various types of polluted land;
	(b) biological treatment of land that has been polluted by hydrocarbons and organic solvents; identification of suitable bacterial cultures.

6. AVAILABILITY OF DRINKING WATER

16. Auxiliary system to render water potable and suitable for human consumption in emergency situations	(a) construction of equipment to render water potable after accidental contamination by high-risk pollutants (chloride compounds, insecticides, heavy metals);
	(b) system for controlling the quality of the water before and after treatment and relative automatic control of the equipment;
	(c) testing of the functional validity of the equipment on a significant number of samples.

7. DEVELOPMENT OF SOFTWARE TECHNOLOGIES FOR THE MONITORING AND MANAGEMENT OF THE ENVIRONMENT

17. Control and management of the quality of the air in urban areas	(a) computer system for the acquisition and checking of data through networks monitoring meteorological conditions and atmospheric and acoustic pollution; forecasts of the evolution of these phenomena and suggested intervention strategies; corrective action, plans for improvement;
	(b) automated program to attribute the respective quotas of pollution to the various sources in the territory; simulation of the diffusion, transport, and deposit of the main chemical pollutants;
	(c) program to evaluate levels of acoustic pollution in urban and industrial areas; qualitative and quantitative identification of the various sources of emissions.
18. Examination of land and water to assist in the management of resources within catchment basins	(a) a computer system able to integrate statistical data from the territory and other data coming from the monitoring network; sources of pollution; hydrogeological environment; rainwater maps; water reserves; piezometric levels of the water table; forecasting of the evolution of any territorial problems or deterioration and suggestions regarding intervention strategies;
	(b) an integrated system able to acquire the necessary information about the movements of water resources;

Table 2 - First National Environmental Research Program: Subjects and Areas of Research (Continued)

7. DEVELOPMENT OF SOFTWARE TECHNOLOGIES FOR THE MONITORING AND MANAGEMENT OF THE ENVIRONMENT (Continued)

	(c) an integrated system that, starting from the monitoring of the collection of underground water and the quality of surface water, gives continuous information about the quality of the water, indicating when interventions are necessary;
	(d) a network for the hydrogeological and geomorphological monitoring of areas highly subject to erosion and characterized by landslides;
	(e) the preparation of a complete system and its testing on a sample area.
19. Studies to optimize the management of the piped distribution of drinking water	(a) a computerized system for the optimal management of the flow of supplies and of any eventual contamination;
	(b) the development of a prototype biosensor able to check toxic levels in polluted water;
	(c) testing of a complete system including the sensors that have been developed, by using a wide range of tests.

The Role of Public-Funded Environmental Research

In this overall picture of activities that are currently directed toward safeguarding the environment, it is of primary importance to underline the need for the progressive extension of research activities. On the one hand activities aimed at the growth of a widespread culture of respect for the ecosystem, and on the other, at the development of new ideas founded on a social commitment to the protection of the environment and the health of man.

For its part, government, supported by the technical-scientific know-how made available by research, should draw up plans to draft new laws and regulations, either for application nationally or as proposals at a European level, and aimed at directing and correcting market forces and the behavior of the community.

Long-term and leading-edge research, which is neglected nowadays both as a consequence of the economic crisis and the tendency within Italian industry to favor short-term solutions, must be compensated for by public sector measures. This until, as a result of ever-increasingly intense technical-scientific activities, prevention is accepted as being preferable to cure.

In order to better identify the needs and priorities to be assigned to the individual environmental research activities, it would be helpful to analyze the areas covered by the objectives of the various programs.

Global Environment. Climatic changes, caused by the greenhouse effect and by the depletion of the ozone layer, continue to be the most important problem and this is where research in this sector must be concentrated.

In order to limit, or however delay, changes in the global climate by restricting the emission of potentially harmful substances into the atmosphere, it is essential to reduce the scientific uncertainties that still exist in this area. This can be done in the first place by monitoring relevant climatic phenomena, then by correlating this data with

the paleoclimate, and also by studying the interaction between sea, ice, and the atmosphere in relation to the greenhouse-effect gases.

The final objective here could be a model of climatic changes in relation to the parameters that can cause the changes.

Regional Environment. One of the causes of environmental damage at regional level and on which research activities should be concentrated is acid rain, with its effects on forests, lakes, and water courses, and on agriculture, as well as on architecture and national treasures.

The effects of damage caused by the emission of concentrations of heat, and the pollution of rivers and enclosed seas by large power stations and large-scale industries, are of more than just local concern and are becoming problems to be dealt with on a regional level.

Also of more than local concern could be hydroelectric capacity, and hydrogeological problems, including those which are the result of natural events.

The spread throughout the regions of pollution which has its origin at local level, is a subject that will have to be researched countrywide. The precipitation of the pollutants present in the air over the regions, the effects of local pollution on water courses and seas (especially enclosed seas such as the Adriatic, and the Mediterranean as a whole), and changes in the ecosystem as a result of concentrations of heat in specific points, are all subjects which should definitely be given priority within the research programs. In the same way, changes in the ecosystem and its effect on human health, must continue to be correlated. In this particular area, the development of biosensors for the recognition of poisonous elements, and for environmental and public health monitoring, is one of the most interesting aspects of research.

Local Environment. The study of pollution in urban areas, caused by traffic exhaust fumes and noise, as well as being the result of a constant flow of pollutants from

domestic heating systems, certainly represents the main priority where research into the local environment is concerned.

To be more specific, an important line of research into the local environment is the search for more in-depth knowledge concerning: a) the causes of pollution, that is, the sources that emit the polluting substances: traffic, heating systems in buildings, industry, garbage incineration, the production of energy, and worksites; b) the processes by which pollution is spread and transformed: carbon monoxide, nitrous oxides, suspended particles, volatile compounds, and ozone in the urban atmosphere; c) the primary and secondary effects of concentrations of pollution on human health, and on the conservation of the country's heritage.

A more rational use of chemical pesticides and fertilizers in rural areas represents a second area of research which is of fundamental importance.

Improvements in equipment for the spreading of agricultural chemicals, the development of diagnostic kits, including those of biological origin, for measuring contamination levels and for detecting the presence of active substances in agricultural products, in the ground, and in the water are, among others, extremely interesting areas of environmental research. Also of interest is an increase in the use of alternative fertilizers of natural origin. These areas of environmental research are definitely local in character, even though the consequences of this type of pollution are much more extensive.

The evaluation of risks connected with certain industrial areas, together with the study of the interaction between industrial plants and the environment, and research into ways and means of reclaiming sites that have been damaged by past use, represent another area where research must be employed with the goal of safeguarding the environment. In this way, it will be possible to avoid the negative consequences of development, and the indiscriminate adoption of measures to relocate industries, or even close them down.

The subject of urban, agricultural, and industrial waste, is a topic which deserves particular attention. Each kind of waste poses particularly difficult problems, such as collection, selection, disposal, transformation, and the recovery and recycling of valuable plastic and metal materials.

In addition, there are many areas in this sector where research can bring about great economic, as well as environmental advantages.

Finally, another sector that has been neglected until now, but deserves attention, is the design and hygiene of enclosed working environments, with particular reference to sources of pollution such as methane gas or LPG [liquid petroleum gas], and to the effects of electromagnetic fields, especially in the domestic environment. Because of the preoccupation that has been caused

amongst the public, this latter subject deserves a special, consistent commitment to research.

The Shortcomings of the National Environmental Research Program

This program, which was drawn up as already stated prior to 1990, takes into consideration the majority, but not all, of the arguments referred to above. The program identifies seven main areas of research, which are in turn divided into 19 general topics. Each topic includes research activities directed at innovative solutions with possible rapid industrial applications, as well as correlated personnel training schemes.

A detailed list of the various areas of research identified in the program is reproduced in Table 2.

A critical observation should be made regarding the title of the program itself. The term "national" leads to the assumption in fact, that the program includes all the environmental research activities being carried out in this country, or at least, all of those which are publicly funded.

Instead, the National Program for Environmental Research does not include, or even mention, many research initiatives that have been launched at national level with public funding.

Among the main programs not included, is the RICSA (Scientific Environmental Research), included in the 1989-1991 three-year program for the protection of the environment. Then there is the special research program for the Adriatic Sea, and the Antarctic program focusing primarily on environmental research.

The RICSA program includes four main research themes:

- Eutrophication. This deals with research into the abnormal production of gelatine and the spread of certain types of algae responsible for toxic phenomena, and into macro-algae, which are alarming and frequent phenomena in our seas.
- Availability of water. There is a need for research, and for the definition of optimal criteria for the management of water resources in accordance with the hydrological characteristics of the various sources and in relation to particular consumption requirements.
- Environmental technical-scientific services. This topic includes the identification and putting together of services for the various environmental sectors, as well as carrying out trials with them in selected areas.
- Refuse. In addition to the research in this sector provided for under Act No. 44/86, and the ministerial decree of 17/2/89 (technologies for the reduction of refuse at origin and for recycling and disposal), research into the biodegradability of plastics or the recycling of basic materials, was identified as a priority.

The amount of funding envisaged as necessary for the development of these four areas of research under Article 11 of Act No. 305/89, was extremely modest, around 20 billion lire, especially when compared with the proposed projects costing hundreds of billions of lire, which had been presented. However, not even these scanty available resources have yet been completely used up.

A 12-billion-lire investment was envisaged for the special research program for the Adriatic Sea, which also happens to cover one of the four topics included in the RICSA program. With this sum, contracts have been entered into with four national research centers (CNR [National Research Council], ENEA [National Agency for New Technologies, Energy, and the Environment], the Higher Institute of Health, and the Central Institute for Research into the Seas).

Finally, to date the Antarctic program managed by ENEA in collaboration with CNR, has cost around 150 billion lire for its eight expeditions to the South Pole. Funding of around 300 billion lire is envisaged for the next five-year period. The lines of environmental and technological research being followed include geomorphological, biological, oceanographic, and atmospheric studies into the characteristics of the Antarctic, with reference to the global environment.

A comparison between the list of topics currently being researched, and current needs and the role which public-funded environmental research should be playing, clearly shows there are several gaps in the national environmental research program.

In the first place, it appears to concentrate on local pollution. In addition the various activities are essentially aimed at the development of technologies and safeguarding the competitiveness of national industries. In a certain sense, the environmental objective seems to be perceived as a consequence of innovation, which appears to be the main scope of the program.

The topic of global environmental protection is completely missing, and the following areas in particular appear to have been neglected:

- the monitoring of global climatic data and its correlation with the paleoclimate;
- the sea-ice-atmosphere interaction in relation to the greenhouse-effect gases (carbon dioxide, CH₄, nitrous oxide, chlorofluorocarbons, etc.);
- modelization of the climate in relation to the various parameters that may cause it to change;
- studies into the technical-scientific possibilities for restricting the emission of the greenhouse-effect gases;
- collection, storage, and reutilization of carbon dioxide;
- studies into the depletion of the ozone layer.

In relation to research activities into how polluting emission spread across the regions, the following topics are not covered:

- Sulphur oxide and nitrogen oxide cycles, from the emission of the gases to precipitation onto the land, in relation to local climatic and orographical conditions;
- the diffusion of concentrated emissions of heat in watercourses and enclosed seas;
- studies into the effects of temperature changes on the ecosystems of rivers and seas;
- the monitoring and control of the spread of regional pollution.

The subject of pollution on the other hand appears to be well-covered, even if some problems should be dealt with in more detail and treated more specifically.

Management of the urban environment in particular is fully covered but there is a case for initiating specific research into:

- the primary and secondary effects of concentrated pollution on human health;
- the primary and secondary mechanisms and effects of pollution on architecture in historic centers, and possible corrective measures;
- studies into the design and hygiene of closed environments and work environments.
- studies into the effects of electromagnetic fields on health.

In addition, no provision has been made for research into how the legislation should be supported and this is a subject of major importance. It is becoming increasingly common, in fact, for promulgated, without the support of technical-scientific know-how in the particular area being regulated. In fact, often not only is there no preestablished basis on which to impose limits, on the emission of this or that substance, for example, but the actual instruments and technology necessary for measuring and controlling the particular pollutant are not available either. In this way, the regulations become inapplicable, thus creating a general negative effect on all environmental legislation.

The subject of "Protected Natural Areas" also deserves more attention as far as research is concerned. The identification of these areas, their management in relation to each specific case, and the evaluation of the economic and social impact made by their institution, would all appear at the moment to be more the fruit of ecological intuition rather than, as should be, the result of scientific research.

On a more general note, social and economic research in the rational use of the territory, a scarce resource in our country, is a subject that deserves a scientific approach

in order to establish the basic guidelines that the authorities will follow when making decisions regarding the location and relocation of industries.

The objective of exercising control, or at least in terms of general direction, over an issue that in the past has been the subject of arbitrary decision by the authorities concerned, or left to chance, or even worse, is certainly worth consideration.

In this case also, there is a need for science and more generally, scientific methods to come to the aid of the authorities and government.

Conclusions

The above considerations give rise to the following conclusions:

1. Concrete and careful attention urgently needs to be given to the 19 topics that represent the contents of the first National Plan for Environmental research.

In this regard, it is necessary to carefully evaluate and update the specific research programs that will be run by the individual concerns chosen to carry out the program. This type of analysis is particularly necessary in consideration of the time that has elapsed between the drawing up of the program and its commencement. It could even lead to the cancellation of certain topics which could have become outdated as a result of technological advances in the past few years.

2. It would seem equally important to proceed with the preparation of a second environmental research program, that would integrate and expand the contents of the first along the lines indicated above. In fact, notwithstanding the uncertainties of the national and international political situation and the difficulties created by the current economic crisis, it is of vital importance to keep advancing as far as the environment, health, and research are concerned, as they represent the greatest challenges of the future.

Fraunhofer Institute Recycles Gypsum as Building Material

MI1507151993 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 2 Jun 93 p 6

[Text] A presentation by the Fraunhofer Institute of Building Physics in Stuttgart has established that gypsum foam could develop into a new market leader as a building material.

Since desulfurization of power station flue gas became standard practice, tonnes of gypsum are being produced as a waste product throughout the year, though unfortunately no one has a use for it in this form and in these quantities, so it ends up on waste dumps. A new patent just taken out by the Stuttgart institute has suddenly changed this situation, as it enables gypsum foam, which

is produced when gypsum powder, a polymer, and water are mixed together, to be used for almost any kind of building components.

Gypsum foam has good mechanical, thermal insulation, and sound absorption properties. A medium-sized firm, Preform, is therefore marketing this innovative building material initially as an open-pored sound-absorbing material.

Germany: Hoechst Develops Improved Silicon Wafers for Solar Cells

MI1607120693 Munich SUEDEUTSCHE ZEITUNG in German 17 Jun 93 p 41

[Text] Hoechst researchers have now developed a new technique for making silicon wafers for solar cells. Production involves melting the raw silicon down at 1,400°C and then cooling it. The blocks thus produced are then sawn into 100-sq cm wafers 0.3 mm thick. The scientists optimized the molten silicon's solidification process to obtain a material that is much more homogeneous than the conventional variety. The researchers expect that the photovoltaic cells produced from it on an industrial scale will have a cell efficiency of 15 percent; they have already achieved 16 percent in a process close to the industrial one. The efficiency of a solar cell indicates the percentage of the solar energy striking the cell that is converted into electrical power. To date, solar cells manufactured on a large scale have had an efficiency of 12 percent, but as much as 23 percent can be achieved in research laboratories using sophisticated manufacturing techniques. As the introduction of the more precise solidification process does not make solar cells any more difficult or expensive to produce, this innovation represents a step along the road towards cheaper and hence more economic solar power.

Largest German Plastics Reprocessing Plant Enters Service

MI2007144693 Wuerzburg UMWELTMAGAZIN in German No 6, Jun 93 pp 40-41

[Text] Germany's largest plant for sorting and processing domestic plastics waste will come on stream any day now in Stapelfeld near Hamburg. It will reprocess 950 kg per hour of soiled and mixed plastics waste to regranulate, which can then be used again to produce plastic products. This capacity is sufficient to recycle the plastics waste produced annually in a region with 500,000 inhabitants—from yogurt pots and cheese boxes through carrier bags to detergent bottles and cling film.

The plant was built by Thyssen Henschel (Kassel) on behalf of the Stapelfeld Waste Incinerator GmbH. Its recycling technology reprocesses plastics waste almost completely at a price of less than 1 German mark [DM] per kg.

The Kassel-based company has been focusing for some years now on the development of physical processes and

the construction of plastics waste recycling plants. Whereas recycling the plastics waste arising during production and processing in industry poses few problems as it is generally unmixed, it proved far more difficult with domestic waste, which is usually heavily soiled and is composed of a large number of different types of plastic.

Since 1990, the firm has been supported in its development of solutions to this problem by the Kassel recycling college. The college, which is the only one of its kind to date, has been assisting Thyssen Henschel in its research and development and in planning and designing purpose-built industrial-scale plants.

By the end of the eighties, the Kassel-based company had brought on stream what is currently the largest plastics waste recycling plant in the world in the Bulgarian capital of Sofia.

Sorting and Regranulation

The recycling process developed by Thyssen Henschel sorts the mixed and soiled plastics from household waste into individual types: polyolefins (PO), polystyrene (PS), and polyvinyl chloride (PVC), and reprocesses it to high-purity regranulates. This recycled product can then be used to produce a large number of plastic products.

In the physical process used, the wastes are first comminuted and washed, and then sorted and dried.

In detail, the process stages are as follows. Comminution is carried out by a slow-running preliminary disintegrator and a cutting mill. The waste material is first comminuted into pieces roughly the size of the palm of a hand in the preliminary comminution stage, then into pieces about 10 mm in size in the cutting mill. The degree of size reduction can be individually adjusted as required by using different screens.

In order to prevent impurities being rubbed into the cut edges of the plastic particles and to minimize the wear on the knives, water is introduced early on in the cutting process.

Washing process: Comminution of the plastics is followed by intensive washing in a drum screen. The diced material passes through a washing drum about 1.5 m long, where it is sprayed continuously with service water. This cleaning process wets the surface of the particles thoroughly with water, a very important factor for the subsequent sorting process. The plastic is then transported by a screw conveyor to the first sorting stage. Stubborn dirt particles are dissolved by the shear forces within the screw conveyor and removed by adding service water.

95-Percent Concentration

In the first sorting stage, the polyolefin fraction is separated out from the heavy, sinking fraction in a float-sink separator. The heavy fraction in domestic waste is composed for the most part of polystyrene, PVC,

and impurities such as aluminum particles adhering to a plastic particle and not removed in the washing process. Four paddles with an infinitely variable speed wet the plastic surface with the separating medium and convey the contents through the tank. The separating medium is a mixture of water and heavy spar, which is recycled within the plant. At the end of the tank, the last paddle discharges the polyolefin fraction, which is about 95-percent pure. The heavy fraction, which has sunk to the bottom, is drawn off continuously from the base of the tank and conveyed to the next separating stage for further processing.

Hydrocyclone stages: In the hydrocyclone separating stage, the PO fraction are fed into an agitated vessel in which the plastic particles are mixed thoroughly. The are then separated in a hydrocyclone, where a polyolefin purity of more than 98 percent is achieved. The plastic is separated from the water on a vibrating screen and, after passing through a drying stage, it is reduced to a residual moisture content of less than 1 percent and granulated.

The heavy fraction from the float-sink separator is fed into a heavy media cyclone (density 1.1 g/cu.cm) for post-sorting. The hydrocyclone raises the polystyrene fraction concentration to more than 98 percent, after which it is also separated from the heavy medium on a vibrating screen then dried to a residual moisture content of less than 1 percent. It is then converted to free-flowing granules by a melting process.

The PVC fraction is treated in the same way in a heavy medium with a density of 1.5 g/cu cm. Processing plastics from domestic waste gives a mixed PVC fraction that can also be used to produce high-grade products if suitable additives are admixed.

Water purification: All the water required for cleaning and sorting the plastics passes through pipelines into a storage vessel from which it is pumped continuously through a filter bag. This filters out the dirt particles in suspension and prepares the water for the subsequent sedimentation stages. After passing through this purification stage, the water can be recycled to the plant for reuse. If the service water is heavily soiled, as in the case of excessive foam formation, for example, it has to be exchanged for fresh water. The waste water is then treated to comply with the discharge conditions laid down by the local authority concerned.

Germany: Lignite Coke Enhances Biological Sewage Treatment

MI2007145193 Wuerzburg UMWELTMAGAZIN
in German No 6, Jun 93 pp 46, 48

[Unattributed article based on a Rheinbraun Sales Company GmbH (Cologne) press release.]

[Text] Lignite products are familiar as a fuel for power stations or as briquettes for generating heat in the home. The range of applications is, however, very much wider. More than 80,000 tonnes per year of the refined product

"brown coal coke" (BCC) are used in environmental engineering, and about 4,000 tonnes/year of this is used in effluent purification.

BCC has a wide range of uses in activated sludge plants for example:

- Enhancing and stabilizing the nitrification process;
- Preventing the formation of bulking sludge;
- Increasing the chemical and biochemical oxygen activation degradation capacity;
- Lowering the sludge index;
- Reducing the amount of excess sludge;
- Improving dewaterability;
- Rendering sludge incineration more economical. In addition, they reduce organic halogen compounds (AOX) in effluent purification, and cleanse highly polluted water (landfill leachate or textile effluent) are by adsorption.

Great Efficacy in the Sludge

These improvements can be explained by the behavior of BCC in the activated sludge. The coke granule is bound to the biofloc and causes the sludge to become physically heavier—the settling rate increases, and the sludge index falls. The amount of excess sludge thereby produced does not increase, and is even reduced. The reason for this is the wide variety of microorganisms, accompanied by a higher concentration of bacteria-consuming single-cell organisms. Moreover, the embedded coke particles form a drainage system that enhances sludge dewatering.

The calorific value of the BCC fed in (30 MJ/kg) and the more compact consistency of the dewatered sludge give a greater specific heat yield when the dry residue is incinerated (5 MJ/kg) than untreated or lime-treated sewage sludge. Back-up oil or gas firing is thus no longer required.

Vigorous Colony Formation

The aerobic degradation capacity of this "compact floc biology" is also increased because the coke particles act as sources of nutrients for the microorganisms. These microorganisms use the high organic nutrient and oxygen concentrations adsorbed onto the surface of the BCC to form vigorous colonies. The coke-supported biocoenosis is characterized by a substantially lower proportion of the filamentous organisms that are usually responsible for the formation of bulking sludge and the unwanted densification of the biomass.

BCC is now being used in more than 20 German sewage works. The practical experience gained there proves that process-stabilizing effects also occur during nitrification. This effect is attributed essentially to reduced silting of the highly volatile nitric bacteria, and buffering of the acid formed by the alkaline coke ash (CaO). Other

reasons are the increased formation of closely packed microorganisms and the adsorptive reduction of nitrification inhibitors by the coke particles. Moreover, the coke behaves as an inert material and settles in the secondary settling tank with the sludge flocs.

Simple, Cheap Technology

Dust-free coke is fed in via an independent silo system in industrial-scale plants; in smaller plants, bagged goods are used with special handling equipment. Moreover, no structural measures are required to refit plants for the use of BCC. The operating costs with a feed of 50 g/cu m are about 0.02 German marks/cu m of effluent. In view of the coke buffer formed in the sludge, a periodic feed is sufficient. The daily quantity can thus be fed into the biological settling tanks in three or four batches.

Siemens-Developed Buoy Detects Waterway Pollution

MI2307082493 Bonn DIE WELT in German 1 Jul 93 p 7

[Text] A recently developed buoy known as Merlin is to monitor future water quality in rivers and lakes. Merlin is around 1.2 meters high, and has a diameter of 80 centimeters; it looks like a 200-liter oil barrel, but contains highly sensitive measuring equipment.

Merlin's sensors provide round-the-clock records of six parameters crucial to water quality: Oxygen and ammonium content, cloudiness, temperature, conductivity, and pH value; these data are relayed by radio to a terminal. If the preset limits are exceeded, then an alarm is activated with the river or lake police or the environment authority.

Merlin can be used flexibly in a variety of waters, according to need. The Sherlock measuring station, on the other hand, is designed for long-term monitoring: The container holding the measuring equipment is permanently installed on the bank of the river or lake, with wires leading from the sensors into the water.

Merlin and Sherlock are powered by batteries or solar collectors: The two environmental detectives were developed at Siemens's laboratories.

Germany: University Researchers Develop PVC Waste Identifier

MI2307082993 Munich SUEDEUTSCHE ZEITUNG in German 1 Jul 93 p 33

[Text] Conventional techniques of separating plastics before recycling have proved either expensive or unreliable. Chemists at Duisburg University have now developed a device that reveals the composition of nonconducting solids in a matter of seconds. This surface discharge spectrometer has a measuring head resembling a dice-cup: This is simply pressed onto the sample. A spark then runs along two metal wires to the sample, vaporizing a small quantity of the substance. This is

analyzed by the spectrometer, and its characteristic atomic structure is displayed on a monitor, showing what the substance is, and what additives it contains.

"There is still the disadvantage that only larger quantities are worth analyzing, and smaller ones, such as yoghurt cartons, still don't get tested," states Alfred Golloch, who has developed the surface discharge spectrometer together with Timur Seidel. Also, analysis still does not solve the problem of separation. Many plastic products consist of several ingredients, which the new device can detect, but obviously cannot separate. According to Golloch, the spectrometer's major applications could be in extracting PVC, which releases dioxin when it is burned together with tensides.

The first production model, due to come onto the market shortly, is customized for use by fire departments, which plan to use the surface discharge spectrometer to detect hazardous substances in fires.

LASERS, SENSORS, OPTICS

France's LETI Developing Laser Microsystems

93WS0513C Paris L'USINE NOUVELLE
TECHNOLOGIES in French 20 May 93 p 22

[Article by Marc Chabreuil: "Laser Systems Go Miniature"; first paragraph is L'USINE NOUVELLE TECHNOLOGIES introduction]

[Text] The microsystems LETI (Laboratory for Electronics and Data Processing Technology) is developing will fit a laser source and its microoptics into a 1 centimeter³ space.

A laser (plus optics) that fits in the palm of your hand, costs just a few francs, and requires no adjustment or maintenance! A 1-2 centimeter³ device fitting that description will star in the "Celebrate Science" days between 4 and 6 June. And the many applications the "laser-chip" will spawn—industrial labeling, automobile anti-collision systems, lidar for atmospheric monitoring—will make it an especial standout.

Indeed, LETI's "materials and optronic devices" section is developing laser microsystems that will combine laser sources and their associated microoptics (lenses 100 μm in diameter), tailored to each potential application. To do this, it is applying its skill and knowledge in the manufacturing of integrated circuits to materials and optics. For instance, the laboratory is cutting doped crystal (identical to YAG crystal) into slices 1 or 2 inches in diameter and 500 to 1,000 μm thick to make the cavity. After polishing this "wafer" and vacuum-depositing a mirror on both sides, LETI cuts it into squares of 25 mm². Then each square need only be excited by a classic laser diode (800 nm wavelength) that is directly bonded to the resonating cavity or linked by fiber optics. "This gives us a 1- μm -wavelength laser beam, with spectral quality superior to that of laser

diodes," points out Engin Molva, who is in charge of the laser group. Besides developing the microoptics, engineers still have another major problem to solve: How to trigger pulsed mode operation with peak power of several hundred watts for a few nanoseconds. "We will be able to manufacture these microtechnologies on an industrial scale in two to three years. Engineers will then be able to use them to design prototypes and demonstrators," promises Engin Molva, who has just one desire: to see the price of laser diodes, the systems' only costly element, fall as they are produced on a large scale.

MICROELECTRONICS

Netherlands: Institute Reduces Microsystem Testing Time

BR2007091493 Rijswijk POLYTECHNISCH
TIJDSCHRIFT
ELEKTRONIKA/ELEKTROTECHNIEK in Dutch
Jun-Jul 93 pp 40-43

[Article by Engineer H.G. Kerkhoff, chief lecturer at the Mesa institute of Twente University in Enschede: "Searching for Errors in Submicron-Range Components—Twente Test Equipment Achieves Good Results"]

[Excerpts] Nowadays, you have to look very closely to locate—and then repair—errors in prototypes of microprocessors and memories. In addition, the extremely minute (submicron) size of the components, the complexity of the systems (more than 10 million transistors), and the short time-to-market lag are all factors urging manufacturers to resort to powerful, but expensive aids. At Twente University, they operate at a slightly more modest scale, but the results are all the more impressive.

In spite of the recession affecting some of the major semiconductor manufacturers, developments in the design, production, and testing of highly complex integrated systems are still running at full speed. At present, no designer will even consider working with anything less than 10 million transistors, 0.5-micron line widths or smaller, or operating speeds of 100 MHz. What is more, the time taken to design, test, and produce these systems (time-to-market) is becoming increasingly shorter. So, there is virtually no time to check the prototype for errors, let alone actually repair them.

Mesa Test Center

At the Mesa research institute of Twente University in Enschede, a frantic search is under way to find ever faster, more efficient ways of designing, manufacturing, and testing microsystems (or parts thereof). These microsystems comprise both analog and digital microelectronics as well as semiconductor sensors and actuators.

The Mesa Test Center (MTC) boasts large-scale automatic test systems. In addition to computer-controlled test apparatus for integrated analog and digital systems,

it also has facilities for measuring ESD [electrostatic discharge], performing reliability tests, and evaluating the manufacture of semiconductors.

Recently, the test center's diagnostic capabilities were extended by its acquisition of an Advantest E1330 electron beam test system, which enables the center to perform measurements on chips within the submicron range. The system was based partly on the familiar scanning electron microscope (SEM), which can greatly magnify small structures. Microscopes of this kind are often used outside the electrotechnical sector, e.g., in medical technology.

The test center also has strong links with FEI, a manufacturer of focused-ion beam systems. This enables Mesa to handle anything from error diagnostics to on-chip modification. In principle, the ultimate aim is to achieve automatic design verification and on-chip error diagnostics. Subsequently, the aim is to integrate the modification routines eliminating these errors into the chip and to verify whether it works correctly. This will eliminate any hidden errors that might appear at a later stage and make it possible to proceed immediately with the production stage. In actual fact, the time required for the entire operation may not exceed one day.

Design Verification and Redesign

The latest development enabling rapid design verification, error diagnostics, and modification has been the advent of the possibility of combining existing tools and databases. This combination is based on a conventional verification system, an electron beam testing system (abbreviated "e-beam" or EB), and a focused-ion beam machine (abbreviated FIB).

It is essential that the design database is present in the latter two machines, including the network and schematic diagram showing the transistors and their connections, the chip layout, and the simulation results.

How Does the Electron Beam Test System Work?

With the electron beam test system it is possible to measure microscopic structures as well as electric fields in very small conducting tracks, whereby information can be obtained on, say, the voltage on a submicron metal conductor on a chip. This means that error analysis can now be performed not only on the signals obtained at the chip's external pins, but also on all of its accessible nodes, of which there may be several million. Consequently, good selection of the points at which measurements are to be taken is essential.

To perform a measurement, a primary electron beam is generated in the electron gun and directed via electro-optical lenses to the desired position on the chip. Next, it scans the chip (X and Y) or comes to rest on a particular

node. The electric field at this node depends on the internal voltage. A positive voltage draws the secondary electrons back to the node, while an earth or negative voltage repels the electrons, enabling their detection by the spectrometer. In terms of the electro-optical image, tracks with a negative voltage will light up, and those with a positive voltage will remain dark.

If the designer wants to position the electron beam on the right node, then all he or she has to do is click the computer mouse onto the node of the layout which the machine has displayed on his screen and the system will then focus the electron beam on that node. At the same time, the software also helps the designer to locate errors on the chip. The computer very rapidly calculates which node requires measuring, positions the electron beam, and compares the results of the measurement with the stored simulation results. A hierarchical error location package enables the error(s) to be localized very rapidly.

The system enables various kinds of measurement, such as real-time imaging, stroboscopic imaging, logic-state mapping, timing diagram, dynamic error imaging, and wave form measurements. Normally, the most important parameters are the position of the beam and the time taken. Another feature of the system is its advanced software, which enables both the beam to be positioned simply and errors to be diagnosed rapidly.

Naturally, this system has its limitations, such as the voltage resolution it achieves, its spatial resolution, the precision of its beam positioning and reproducibility, and its speed in measuring non-repeating signals—not to forget the test times required for each measurement and the high cost of acquiring the system.

What is truly astonishing is that extremely basic design errors can still sometimes occur, in spite of the existence of advanced CAD [computer-aided design] programs which include all kinds of simulation and verification procedures. To take a real-life example, one manufacturer of microprocessors made the error of producing chips on which the bus lines were inverted, thus breaking a large number of connections. As a result, new connections had to be included in the prototype before the system could be made to work.

How Does the FIB Machine Work?

The FIB machine offers designers the opportunity, during analysis of the prototype, to repair errors directly on the chip and then take fresh measurements using the electron beam tester. This process can be repeated until the chip works and the designer is sure that no redesign is necessary. The FIB machine enables the designer to either make or break connections on the chip. The only thing he has to do is use the mouse to indicate on the layout displayed by the computer which connections he wishes to break or establish. The navigation software

used for this purpose automatically aims the ion beam at the desired points and carries out the necessary actions. [passage omitted]

Future

In the future, the need for very rapid, automated design verification and modification will increase. One method involves physically integrating the electron beam test machine into the FIB machine, and offering the combination as a single unit. In addition, in view of the explosive spread of analog/digital integrated systems, the Mesa Institute is also researching to which extent EB systems can accurately measure analog voltages. However, there is also all kinds of optical technology ready to compete with EB systems, and work is even being done on mechanical nanometer probes.

TELECOMMUNICATIONS

EC PTT Ministers Sign HDTV Agreement

*MI2007100693 Eschborn NACHRICHTEN FUER
AUSSENHANDEL in German 17 Jun 93 p 1*

[Text] EC posts and telecommunications ministers have reached agreement in principle on introducing high-definition television (HDTV) in Europe. According to diplomatic circles in Luxembourg, the EC plans to provide a total of ECU228 million for the project over the next four years via an action plan designed to accelerate the introduction of HDTV channels throughout Europe using the 16:9 format, regardless of the transmission standard in use. This EC funding is subject to industry contributing at least ECU177 million to the project.

AEROSPACE

DASA Heads Argentinian Telecom Satellite Consortium

MI1507135893 Munich SUEDEDEUTSCHE ZEITUNG in German 10 Jun 93 p 30

[Text] Following the signing of a licence agreement for the Nahuel (Puma) commercial satellite-based communication system, the German aerospace industry is for the first time entering the satellite operating market, which is expanding rapidly worldwide and has become very lucrative for operators such as the international companies Intelsat and Marisat.

In the presence of Argentinian President Carlos Menem, representatives of the national telecommunications administration and an international consortium of companies led by German Aerospace (DASA) have signed a licence granted for 24 years in the Casa Rosada official residence in Buenos Aires. It authorizes the placing of five satellites in geostationary orbit positions. The first satellite will be launched at the end of 1996.

Direct Reception

Nahuel will provide not only Argentina but also Brazil, Chile, Paraguay, and Uruguay with transmission capacities for television reception and data and telephone services—except for publicly provided services. The satellite will make it possible to receive television programs directly with a dish antenna only one meter in diameter.

The launch of the \$70-million satellite will require an investment amounting to \$200 million, including a ground station and the costly insurance for the launch; the consortium, the users, and the investors will have to put this sum up. In the meantime, Argentina will take over two Anik satellites acquired from the Canadians, which will immediately provide the country's telecom service. President Menem expressed his view that modern satellite technology can be used to enable his country, which has substantial mineral resources and an industrious population, to spread information and knowledge. In the eighth largest country in the world, telecommunications constituted an indispensable educational tool. DASA board member Werner Heinzmann regarded the step as another bridge between Europe and South America. Entering the satellite operation business was a part of the Daimler-Benz philosophy of an integrated technological company.

The next step in setting up the Nahuel system will be the incorporation of the operating company Nahuelsat in Buenos Aires to which, in Europe, DASA, France's Aerospatiale, and Italy's Alenia Spazio belong. Argentinean and international shareholders will follow in a second stage. Surprisingly, the state-owned Brazilian telecom company, Embratel, a founder member of the Nahuel consortium, failed to attend the signing, with the result that the consortium will have to be formed afresh.

For 36 Television Channels

The Nahuel I satellite will be based on the existing Eutelsat II platform and have 18 transponders. It is expected to have a service life of 12 years. By way of an example, 36 television channels can broadcast at the same time via the satellite, or 18,000 telephone conversations held simultaneously.

ENERGY, ENVIRONMENT

German Environmental Know-How Transferred to Thailand

MI2007100393 Eschborn NACHRICHTEN FUER AUSSENHANDEL in German 18 Jun 93 p 6

[Text] The expanding market in Thailand for environmental conservation equipment offers attractive scope for German firms working in this sector. More and more operators of factories and production processes causing environmental pollution are coming under pressure from the government to invest in effective environmental technology. The demand for recycling or material recovery equipment is also increasing.

A report just presented by the German Investment and Development Company (DEG) points to the Bangkok conurbation's dependence on ever-scarcer water supplies. It also mentions the inadequate infrastructure for effluent collection and treatment. Another unsolved problem is that of the environment-friendly disposal of the growing quantities of domestic and industrial waste.

The following investment programs, listed in the DEG report, are intended to address the problems that represent the greatest threat to the environment: Bangkok Metropolitan Administration (BMA) effluent program (10.5 billion baht); BMA solid waste disposal program (6.0 billion baht); Public Works Department's effluent treatment program for municipal areas outside Bangkok (5.7 billion baht); Industrial Estates Authority of Thailand's infrastructure improvement program (no value stated); regional environmental protection plan for the eastern seaboard (0.9 billion baht).

The report describes two likely market development scenarios over the next 10 years. The scenario that assumes a growth rate estimates the environmental technology market for 1993 to 2003 at around 234 billion baht. The lower-growth scenario assumes a market volume of around 110 billion baht.

The greatest demand for environmental technology comes from the drinking water and effluent treatment sectors (35 percent and 40 percent respectively). The greatest sales success is achieved by suppliers whose contacts with the small number of local agencies date back many years. Imports from Japan and the United States each account for around 25 percent of the present market. The European share of the market is estimated at 20 percent and the local share at around 30 percent.

It is predicted that agents and Thai firms that manufacture locally developed systems based on foreign know-how and the selective import of key components will in future become increasingly important in servicing the market. Suppliers should also guarantee constant updating for the plants that they set up, so as to satisfy the need for more innovation and improved efficiency. In this connection, the major role played by local assembly in project implementation is welcomed by the Thai authorities.

The (English-language) environment report on Thailand can be obtained from DEG, at the price of 150 German marks. The address is: DEG (attention Frau Spoelgen), Belvederestr. 40, D-50933 Cologne (Mungersdoerf), tel. (0221) 4986-230, fax (0221) 4989-104.

MICROELECTRONICS

Siemens Acquires Chip Technology From Israeli DSP Group

MI1507145893 Munich MARKT & TECHNIK
in German 11 Jun 93 pp 1, 3

[Text] Siemens Semiconductors has recently acquired a license on the Israeli DSP Group's DSP technology following an agreement with the group that enables the German chip manufacturer to fill a major gap in its technology range. This new technology covers the entire range of fixed-point, floating-point, and algorithm-specific solutions, and will particularly benefit the Information Technology Division, which makes chips and chip sets for mobile communications. The next GSM [Global System for Mobile Communications] gold chip generation will have a single-chip voice codec, accompanied by the newly acquired DSP technology, the complete digital section thus being integrated on two chips up to the HF interface. Siemens can thus claim to have the most compact GSM chip set to date from the integration point of view. The new solution is expected to be available a year from now, at the earliest: It will be optimized for the planned half-rate codec, and will be flexible in relation to Motorola's and ANT's algorithms, final decisions on which have not yet been made. However, the DSP technology will also be useful for other products, such as DECT chips, or even for integration into ECO51- or ECO166-series modular microcontrollers.

SCIENCE & TECHNOLOGY POLICY

Brazil S&T Woes

93WS0605A Sao Paulo O ESTADO DE SAO PAULO
in Portuguese 21 Jun 93 p 7

[Text] At the last cabinet meeting, the minister of science and technology, Jose Israel Vargas, attested to the breakdown of the science and technology (S&T) sector in

Brazil. Possibly for this reason, the sector not only escaped the cuts that the government is attempting to make in the budget, but also obtained more funds.

As the minister declared, the government's "policy decision" to lend prestige to the pursuit of knowledge in our country is so firm that President Itamar Franco will send to the Congress a provisional order allocating funds obtained from the Privatization Program for projects in that field. Four projects were awarded funds: the INPE's [National Institute of Space Research] satellite launch vehicle, the Scientific Computation Laboratory's super-computer, the synchronous light project, and the research program in Antarctica.

Apart from any evaluation of the projects, the policy decision cited by Minister Vargas deserves attention. After the efficiency of the scorched earth policy toward scientific research in Brazil from 1990 to 1992, a guarantee that science and technology will regain prestige through a contribution of funds from privatization might sound like propaganda. In 1987, Brazil spent 0.64 percent of its GDP on science and technology; in 1990, 0.41 percent was invested; in 1991, only 0.37 percent; and last year, the figure was 0.31 percent of the GDP. These data are from the Ministry of Science and Technology itself which, in 1992, had an estimated budget of \$800 million, and succeeded in executing a budget of less than \$400 million. For those who prefer to think comparatively in assessing performance, these funds made it possible to provide only 400 researchers for every million Brazilians; whereas South Korea has 2,000 per million, and Japan, 6,000 per million inhabitants.

The serious aspect is that even these meager funds have been applied in a questionable manner.

Professor Walter Colli, of the USP [University of Sao Paulo], in an article in the Sao Paulo press, made it clear that the supply of study grants between 1986 and 1992 remained stable, whereas the funds for research projects declined by a factor of 27. In other words, the "users" remained, because it is very difficult to refuse grants to the universities. However, the objects of research, so to speak, disappeared. In 1992, the CNPq [National Research Council] applied only \$7.6 million to research projects; whereas the Fapesp [Sao Paulo Federation To Support Research] applied over \$90 million for Sao Paulo State alone! Rather than attempt to restore a proper relationship between projects and research and study grants, Minister Vargas prefers to give priority to four projects. Meanwhile, only 9.3 percent of the doctoral candidates and 10.3 percent of the candidates for the master's degree complete their work. And yet, because they receive what they are receiving for doing research, if the laboratory has not been closed, the researcher's payroll is nevertheless maintained.

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